

## PATENT ASSIGNMENT COVER SHEET

Electronic Version v1.1  
 Stylesheet Version v1.2

EPAS ID: PAT6478922

|                                    |                                                               |                       |
|------------------------------------|---------------------------------------------------------------|-----------------------|
| <b>SUBMISSION TYPE:</b>            | NEW ASSIGNMENT                                                |                       |
| <b>NATURE OF CONVEYANCE:</b>       | AMENDED AND RESTATED INTELLECTUAL PROPERTY SECURITY AGREEMENT |                       |
| <b>CONVEYING PARTY DATA</b>        |                                                               |                       |
| <b>Name</b>                        |                                                               | <b>Execution Date</b> |
| TQ DELTA LLC                       |                                                               | 12/31/2020            |
| <b>RECEIVING PARTY DATA</b>        |                                                               |                       |
| <b>Name:</b>                       | ALTER DOMUS (US) LLC                                          |                       |
| <b>Street Address:</b>             | 225 W. WASHINGTON ST., 9TH FLOOR                              |                       |
| <b>City:</b>                       | CHICAGO                                                       |                       |
| <b>State/Country:</b>              | ILLINOIS                                                      |                       |
| <b>Postal Code:</b>                | 60606                                                         |                       |
| <b>PROPERTY NUMBERS Total: 227</b> |                                                               |                       |
| <b>Property Type</b>               | <b>Number</b>                                                 |                       |
| Patent Number:                     | 5497398                                                       |                       |
| Patent Number:                     | 5631610                                                       |                       |
| Patent Number:                     | 5636246                                                       |                       |
| Patent Number:                     | 5715280                                                       |                       |
| Patent Number:                     | 5751716                                                       |                       |
| Patent Number:                     | 5832030                                                       |                       |
| Patent Number:                     | 6445730                                                       |                       |
| Patent Number:                     | 6731695                                                       |                       |
| Patent Number:                     | 6748016                                                       |                       |
| Patent Number:                     | 6760373                                                       |                       |
| Patent Number:                     | 6801570                                                       |                       |
| Patent Number:                     | 6870888                                                       |                       |
| Patent Number:                     | 6961369                                                       |                       |
| Patent Number:                     | 7180938                                                       |                       |
| Patent Number:                     | 7292627                                                       |                       |
| Patent Number:                     | 7451379                                                       |                       |
| Patent Number:                     | 7453881                                                       |                       |
| Patent Number:                     | 7471721                                                       |                       |
| Patent Number:                     | 7558329                                                       |                       |
| Patent Number:                     | 7570686                                                       |                       |

| Property Type  | Number  |
|----------------|---------|
| Patent Number: | 7636389 |
| Patent Number: | 7656976 |
| Patent Number: | 7697598 |
| Patent Number: | 7769104 |
| Patent Number: | 7796705 |
| Patent Number: | 7809028 |
| Patent Number: | 7831890 |
| Patent Number: | 7835430 |
| Patent Number: | 7836381 |
| Patent Number: | 7844882 |
| Patent Number: | 7889784 |
| Patent Number: | 7925958 |
| Patent Number: | 7978706 |
| Patent Number: | 7978753 |
| Patent Number: | 7979778 |
| Patent Number: | 8073041 |
| Patent Number: | 8090008 |
| Patent Number: | 8102909 |
| Patent Number: | 8218610 |
| Patent Number: | 8238412 |
| Patent Number: | 8276048 |
| Patent Number: | 8335271 |
| Patent Number: | 8335956 |
| Patent Number: | 8355427 |
| Patent Number: | 8374226 |
| Patent Number: | 8391191 |
| Patent Number: | 8407546 |
| Patent Number: | 8422511 |
| Patent Number: | 8432956 |
| Patent Number: | 8437382 |
| Patent Number: | 8462835 |
| Patent Number: | 8468411 |
| Patent Number: | 8495473 |
| Patent Number: | 8516337 |
| Patent Number: | 8594162 |
| Patent Number: | 8595577 |
| Patent Number: | 8607126 |
| Patent Number: | 8611404 |

| Property Type  | Number  |
|----------------|---------|
| Patent Number: | 8625660 |
| Patent Number: | 8634449 |
| Patent Number: | 8645784 |
| Patent Number: | 8649305 |
| Patent Number: | 8718158 |
| Patent Number: | 8743931 |
| Patent Number: | 8743932 |
| Patent Number: | 8750352 |
| Patent Number: | 8782498 |
| Patent Number: | 8792574 |
| Patent Number: | 8793553 |
| Patent Number: | 8831031 |
| Patent Number: | 8837610 |
| Patent Number: | 8913649 |
| Patent Number: | 8929423 |
| Patent Number: | 8929470 |
| Patent Number: | 8937988 |
| Patent Number: | 8984366 |
| Patent Number: | 9014193 |
| Patent Number: | 9014243 |
| Patent Number: | 9065886 |
| Patent Number: | 9069718 |
| Patent Number: | 9094268 |
| Patent Number: | 9094348 |
| Patent Number: | 9154354 |
| Patent Number: | 9191039 |
| Patent Number: | 9264533 |
| Patent Number: | 9276612 |
| Patent Number: | 9286251 |
| Patent Number: | 9300324 |
| Patent Number: | 9300601 |
| Patent Number: | 9319512 |
| Patent Number: | 9479637 |
| Patent Number: | 9485055 |
| Patent Number: | 9485128 |
| Patent Number: | 9521003 |
| Patent Number: | 9547608 |
| Patent Number: | 9621198 |

| Property Type       | Number   |
|---------------------|----------|
| Patent Number:      | 9749235  |
| Patent Number:      | 9755876  |
| Patent Number:      | 9838531  |
| Patent Number:      | 9893921  |
| Patent Number:      | 9894014  |
| Patent Number:      | 9898220  |
| Patent Number:      | 9973624  |
| Patent Number:      | 10044473 |
| Patent Number:      | 10049003 |
| Patent Number:      | 10187240 |
| Patent Number:      | 10264119 |
| Patent Number:      | 10341261 |
| Patent Number:      | 10346243 |
| Patent Number:      | 10409510 |
| Patent Number:      | 10419059 |
| Patent Number:      | 10484140 |
| Patent Number:      | 10498495 |
| Patent Number:      | 10567112 |
| Patent Number:      | 10579291 |
| Patent Number:      | 10623559 |
| Patent Number:      | 10708104 |
| Patent Number:      | 10805040 |
| Patent Number:      | 10833809 |
| Application Number: | 09768275 |
| Application Number: | 09836295 |
| Application Number: | 09882046 |
| Application Number: | 10175815 |
| Application Number: | 10202688 |
| Application Number: | 10597482 |
| Application Number: | 10631745 |
| Application Number: | 10743946 |
| Application Number: | 10778083 |
| Application Number: | 10802867 |
| Application Number: | 10834193 |
| Application Number: | 11058289 |
| Application Number: | 11090183 |
| Application Number: | 11140246 |
| Application Number: | 11200002 |



| Property Type       | Number   |
|---------------------|----------|
| Application Number: | 11242024 |
| Application Number: | 11289516 |
| Application Number: | 11430251 |
| Application Number: | 11434249 |
| Application Number: | 11616630 |
| Application Number: | 11748806 |
| Application Number: | 11972340 |
| Application Number: | 12383056 |
| Application Number: | 12478577 |
| Application Number: | 12615077 |
| Application Number: | 12640838 |
| Application Number: | 12783733 |
| Application Number: | 12783737 |
| Application Number: | 12783744 |
| Application Number: | 12783755 |
| Application Number: | 12783788 |
| Application Number: | 12783796 |
| Application Number: | 12783801 |
| Application Number: | 12783825 |
| Application Number: | 12783839 |
| Application Number: | 13330943 |
| Application Number: | 13467392 |
| Application Number: | 14285911 |
| Application Number: | 14485937 |
| Application Number: | 14577769 |
| Application Number: | 14724345 |
| Application Number: | 14757630 |
| Application Number: | 14865966 |
| Application Number: | 14932599 |
| Application Number: | 15054499 |
| Application Number: | 15077506 |
| Application Number: | 15084788 |
| Application Number: | 15180274 |
| Application Number: | 15298817 |
| Application Number: | 15304920 |
| Application Number: | 15479866 |
| Application Number: | 16428232 |
| Application Number: | 16544003 |

| Property Type       | Number    |
|---------------------|-----------|
| Application Number: | 16561835  |
| Application Number: | 16569144  |
| Application Number: | 16781802  |
| Application Number: | 17027196  |
| Application Number: | 60072447  |
| Application Number: | 60090891  |
| Application Number: | 60109876  |
| Application Number: | 60144562  |
| Application Number: | 60164134  |
| Application Number: | 60172343  |
| Application Number: | 60174865  |
| Application Number: | 60177944  |
| Application Number: | 60197727  |
| Application Number: | 60212233  |
| Application Number: | 60224308  |
| Application Number: | 60241468  |
| Application Number: | 60241664  |
| Application Number: | 60278936  |
| Application Number: | 60283467  |
| Application Number: | 60287968  |
| Application Number: | 60293034  |
| Application Number: | 60309631  |
| Application Number: | 60327440  |
| Application Number: | 60400550  |
| Application Number: | 60549804  |
| Application Number: | 60555982  |
| Application Number: | 60613594  |
| Application Number: | 60618269  |
| Application Number: | 60619618  |
| Application Number: | 60792236  |
| Application Number: | 60849650  |
| Application Number: | 60989542  |
| Application Number: | 61011267  |
| Application Number: | 61183845  |
| Application Number: | 61985168  |
| PCT Number:         | US0019247 |
| PCT Number:         | US0030958 |
| PCT Number:         | US0100418 |

| Property Type | Number    |
|---------------|-----------|
| PCT Number:   | US0102341 |
| PCT Number:   | US0112555 |
| PCT Number:   | US0132503 |
| PCT Number:   | US0141015 |
| PCT Number:   | US0209411 |
| PCT Number:   | US0224326 |
| PCT Number:   | US0231649 |
| PCT Number:   | US0323965 |
| PCT Number:   | US0533922 |
| PCT Number:   | US0536015 |
| PCT Number:   | US9406713 |
| PCT Number:   | US9515115 |
| PCT Number:   | US9708209 |
| PCT Number:   | US9708222 |
| PCT Number:   | US9708549 |
| PCT Number:   | US9708756 |
| PCT Number:   | US9914467 |

**CORRESPONDENCE DATA**

**Fax Number:** (202)887-4288

*Correspondence will be sent to the e-mail address first; if that is unsuccessful, it will be sent using a fax number, if provided; if that is unsuccessful, it will be sent via US Mail.*

**Phone:** 2028874000

**Email:** dlee@akingump.com

**Correspondent Name:** DAVID C. LEE

**Address Line 1:** 2001 K STREET N.W.

**Address Line 2:** AKIN GUMP STRAUSS HAUSER & FELD LLP

**Address Line 4:** WASHINGTON, D.C. 20006

|                                |                                                            |
|--------------------------------|------------------------------------------------------------|
| <b>ATTORNEY DOCKET NUMBER:</b> | 697820.0023                                                |
| <b>NAME OF SUBMITTER:</b>      | DAVID C. LEE                                               |
| <b>SIGNATURE:</b>              | /David C. Lee/                                             |
| <b>DATE SIGNED:</b>            | 01/04/2021                                                 |
|                                | This document serves as an Oath/Declaration (37 CFR 1.63). |

**Total Attachments: 25**

source=TQ Delta - A&R IP Security Agreement#page1.tif

source=TQ Delta - A&R IP Security Agreement#page2.tif

source=TQ Delta - A&R IP Security Agreement#page3.tif

source=TQ Delta - A&R IP Security Agreement#page4.tif

source=TQ Delta - A&R IP Security Agreement#page5.tif

source=TQ Delta - A&R IP Security Agreement#page6.tif

source=TQ Delta - A&R IP Security Agreement#page7.tif  
source=TQ Delta - A&R IP Security Agreement#page8.tif  
source=TQ Delta - A&R IP Security Agreement#page9.tif  
source=TQ Delta - A&R IP Security Agreement#page10.tif  
source=TQ Delta - A&R IP Security Agreement#page11.tif  
source=TQ Delta - A&R IP Security Agreement#page12.tif  
source=TQ Delta - A&R IP Security Agreement#page13.tif  
source=TQ Delta - A&R IP Security Agreement#page14.tif  
source=TQ Delta - A&R IP Security Agreement#page15.tif  
source=TQ Delta - A&R IP Security Agreement#page16.tif  
source=TQ Delta - A&R IP Security Agreement#page17.tif  
source=TQ Delta - A&R IP Security Agreement#page18.tif  
source=TQ Delta - A&R IP Security Agreement#page19.tif  
source=TQ Delta - A&R IP Security Agreement#page20.tif  
source=TQ Delta - A&R IP Security Agreement#page21.tif  
source=TQ Delta - A&R IP Security Agreement#page22.tif  
source=TQ Delta - A&R IP Security Agreement#page23.tif  
source=TQ Delta - A&R IP Security Agreement#page24.tif  
source=TQ Delta - A&R IP Security Agreement#page25.tif

EXECUTION VERSION

AMENDED AND RESTATED INTELLECTUAL PROPERTY SECURITY AGREEMENT

This AMENDED AND RESTATED INTELLECTUAL PROPERTY SECURITY AGREEMENT (as amended, restated, amended and restated, supplemented or otherwise modified from time to time, the “**IP Security Agreement**”), dated as of December 31, 2020, is made by each undersigned grantor (each, a “**Grantor**”, and, collectively, the “**Grantors**”) in favor of ALTER DOMUS (US) LLC, a Delaware limited liability company, as collateral agent for its own benefit and the benefit of the Lenders (as defined in the Credit Agreement defined below) (in such capacity, together with its successor and assigns in such capacity, the “**Collateral Agent**”). Capitalized terms used herein and not otherwise defined herein shall have the meanings assigned to such terms in the Credit Agreement or the Security Agreement (as defined below), as applicable.

WHEREAS, the Borrower, ALTER DOMUS (US) LLC, as Administrative Agent (as defined therein), the Collateral Agent and the Lenders from time party thereto, are each party to that certain Amended and Restated Credit Agreement, dated as of December 31, 2020 (as amended, restated, amended and restated, supplemented or otherwise modified from time to time, the “**Credit Agreement**”), pursuant to which the Lenders have agreed, among other things, to continue the existing term loan and extend further credit to the Borrower in the form of delayed draw term loans upon the terms and subject to the conditions specified therein;

WHEREAS, in connection with the Credit Agreement, each Grantor has entered into the Amended and Restated Security Agreement, dated as of December 31, 2020 (as amended, restated, amended and restated, supplemented or otherwise modified from time to time, the “**Security Agreement**”) in order to induce the Lenders to make and continue to make, as applicable, Loans; and

WHEREAS, under the terms of the Security Agreement, each Grantor has granted to the Collateral Agent, for the ratable benefit of the Credit Parties, a security interest in, among other property, certain intellectual property of such Grantor, and has agreed as a condition thereof to execute this IP Security Agreement for recording with the United States Patent and Trademark Office and the United States Copyright Office, as the case may be.

NOW, THEREFORE, for good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, each Grantor agrees as follows:

(a) Grant of Security Interest. As security for the prompt and complete payment or performance, as the case may be, in full of the Secured Obligations, each Grantor hereby grants to the Collateral Agent for itself and the ratable benefit of the Credit Parties, a security interest in all of its right, title and interest in and to all of the following personal property, whether now owned by or owing to or hereafter acquired by or arising in favor of such Grantor (collectively, the “**IP Collateral**”):

(i) all Trademark registrations and applications for Trademark registration in the United States Patent and Trademark Office listed on Schedule I hereto;

(ii) all issued Patents and pending Patent applications in the United States Patent and Trademark Office listed on Schedule II hereto;

(iii) all Copyright registrations and pending applications for Copyright registration in the United States Copyright Office listed on Schedule III; and

(iv) all Proceeds and products of any and all of the foregoing and all supporting obligations, collateral security and guarantees given by any Person with respect to any of the foregoing;

provided, however, that notwithstanding any of the other provisions herein (and notwithstanding any recording of the Collateral Agent's Lien made in the United States Patent and Trademark Office, United States Copyright Office, or other registry office in any other jurisdiction), this Short-Form IP Security Agreement shall not constitute a grant of a security interest in any Trademark applications filed in the United States Patent and Trademark Office on the basis of such Grantor's "intent-to-use" such trademark, unless and until acceptable evidence of use of the Trademark has been filed with and accepted by the United States Patent and Trademark Office pursuant to Section 1(c) or Section 1(d) of the Lanham Act (15 U.S.C. 1051, et seq.), to the extent that granting a lien in such Trademark application prior to such filing would adversely affect the enforceability or validity of such Trademark application.

(b) Security for Secured Obligations. The grant of a security interest in the IP Collateral by each Grantor under this IP Security Agreement secures the payment of all Secured Obligations of such Grantor now or hereafter existing under or in respect of the Loan Documents, whether direct or indirect, absolute or contingent, and whether for principal, reimbursement obligations, interest, premiums, penalties, fees, indemnifications, contract causes of action, costs, expenses or otherwise, subject to the terms and provisions thereof.

(c) Recordation. This IP Security Agreement has been executed and delivered by each Grantor for the purpose of recording the grant of security interest herein with the United States Patent and Trademark Office and the United States Copyright Office, as the case may be. Each Grantor authorizes and requests that the Register of Copyrights, the Commissioner for Patents and the Commissioner for Trademarks and any other applicable government officer record this IP Security Agreement.

(d) Execution in Counterparts. This IP Security Agreement may be executed in any number of counterparts, each of which when so executed shall be deemed to be an original and all of which taken together shall constitute one and the same agreement.

(e) Grants, Rights and Remedies. This IP Security Agreement has been entered into in conjunction with the provisions of the Security Agreement. The Grantor does hereby acknowledge and confirm that the grant of the security interest hereunder to, and the rights and remedies of, the Collateral Agent with respect to the Collateral are more fully set forth in the Security Agreement, the terms and provisions of which are incorporated herein by reference as if fully set forth herein. In the event of any conflict between the terms of this IP Security Agreement and the terms of the Security Agreement, the terms of the Security Agreement shall govern.

(f) Governing Law. THIS IP SECURITY AGREEMENT SHALL BE GOVERNED BY, AND CONSTRUED IN ACCORDANCE WITH, THE LAW OF THE STATE OF NEW YORK.

(g) General. Sections 10.04, 10.14(b) and 10.15 of the Credit Agreement are hereby incorporated by reference into this IP Security Agreement *mutatis mutandis* and shall apply hereto.

(h) Severability. In case any one or more of the provisions contained in this IP Security Agreement should be held invalid, illegal or unenforceable in any respect, the validity, legality and enforceability of the remaining provisions contained herein and in the Security Agreement shall not in any way be affected or impaired thereby (it being understood that the invalidity of a particular provision in a particular jurisdiction shall not in and of itself affect the validity of such provision in any other jurisdiction). The parties hereto shall endeavor in good-faith negotiations to replace the invalid, illegal or unenforceable provisions with valid provisions the economic effect of which comes as close as possible to that of the invalid, illegal or unenforceable provisions.

(i) Amendment and Restatement. This IP Security Agreement is an amendment and restatement but not a novation of that certain Intellectual Property Security Agreement, dated as of October 5, 2018, in favor of the Collateral Agent (as amended, modified or supplemented prior to the date hereof, the “**Original IP Security Agreement**”). All Liens and security interests securing payment of the Secured Obligations under the Original IP Security Agreement are hereby collectively, renewed, extended, ratified and brought forward as security for the payment and performance of the Secured Obligations. Each Grantor hereby (i) reaffirms each Lien, pledge and security interest granted to the Collateral Agent under or in connection with the Original IP Security Agreement, (ii) agrees that after giving effect to this IP Security Agreement such Liens, pledges and security interests shall continue in full force and effect, and (iii) agrees that such Liens, pledges and security interests continue to secure the full and prompt payment and performance of all of the Secured Obligations.

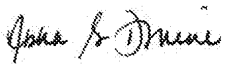
[Remainder of Page Intentionally Blank]

IN WITNESS WHEREOF, each Grantor has caused this IP Security Agreement to be duly executed and delivered by its officer thereunto duly authorized as of the date first above written.

**TQ DELTA LLC**, as Grantor

By: TQCAP GP, LLC, its manager

By: TECHQUITY CAPITAL MANAGEMENT,  
LLC, its sole member

By:   
Name: Abha Divine  
Title: Managing Director

[Signature Page to A&R IP Security Agreement]



ACCEPTED AND AGREED  
as of the date first above written.

ALTER DOMUS (US) LLC,  
as Collateral Agent

By: J. K.  
Name: Jon Kirschmeier  
Title: Associate Counsel

[Signature Page to A&R IP Security Agreement]

**Schedule I**

Trademarks

UNITED STATES TRADEMARKS:

Registrations / Applications:

| OWNER           | REGISTRATION/ APPLICATION NUMBER | TRADEMARK |
|-----------------|----------------------------------|-----------|
| TQ Delta<br>LLC | 5110447                          | TQ DELTA  |
|                 |                                  |           |

**Schedule II**

Patents

(see attached)

TQ DELTA, LLC  
Privileged and Confidential / Attorney Client Communication

| Reference #        | Title                                                                                                                                    | Country ID | Status    | Serial #       | Filed Date | Publication #      | Patent #   | Issue Date | Expiration Date |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|----------------|------------|--------------------|------------|------------|-----------------|
| 6936-2-CON-2       | Systems and Methods for Establishing a Diagnostic Transmission Mode and Communicating Over the Same                                      | US         | ISSUED    | 10/619,691     | 7/16/03    | US 2004-0202237 A1 | 7,570,686  | 8/4/09     | 10/1/22         |
| 6936-2-CON-2-1     | Multicarrier Modulation Messaging for Frequency Domain Received Idle Channel Noise Information                                           | US         | ISSUED    | 12/477,742     | 6/3/09     | US 2009-0238254 A1 | 7,835,430  | 11/16/10   | 1/8/21          |
| 6936-2-CON-2-1-1   | Multicarrier Modulation Messaging for Power Level Per Subchannel Information                                                             | US         | EXPIRED   | 12/779,660     | 5/13/10    | US 2010-0226418 A1 | 8,238,412  | 8/7/12     | 4/7/20          |
| 6936-2-CON-2-1-2   | Multicarrier Modulation Messaging for SNR Per Subchannel During Showtime Information                                                     | US         | ISSUED    | 12/779,708     | 5/13/10    | US 2010-0220775 A1 | 7,889,784  | 2/15/11    | 1/8/21          |
| 6936-2-CON-2-1-3   | Systems and Methods for Establishing a Diagnostic Transmission Mode and Communicating Over the Same                                      | US         | ISSUED    | 13/004,254     | 1/11/11    | US 2011-0103443 A1 | 8,634,449  | 1/21/14    | 7/4/21          |
| 6936-2-CON-2-1-4   | Multicarrier Modulation Messaging for Power Level Per Subchannel Information                                                             | US         | ISSUED    | 13/476,310     | 5/21/12    | US 2012-0230476 A1 | 8,432,596  | 4/30/13    | 1/8/21          |
| 6936-2-CON-2-1-5   | Systems and Methods for a Transceiver to Transmit or Receive Test Information Over a Communication Channel Using Multicarrier Modulation | US         | ISSUED    | 13/873,892     | 4/30/13    | US 2013-0243049 A1 | 8,743,931  | 6/3/14     | 1/8/21          |
| 6936-2-CON-2-1-6   | Systems and Methods for Establishing a Diagnostic Transmission Mode and Communicating Over the Same                                      | US         | ISSUED    | 14/153,282     | 1/13/14    | US 2014-0126616 A1 | 8,929,423  | 1/6/15     | 1/8/21          |
| 8303-2-CON-2-1-7   | Systems and Methods for Establishing a Diagnostic Transmission Mode and Communicating Over the Same                                      | US         | ISSUED    | 14/282,254     | 5/20/14    | US 2014-0254645 A1 | 9,319,512  | 4/19/16    | 1/8/21          |
| 8303-2-CON-2-1-8   | Systems and Methods for Establishing a Diagnostic Transmission Mode and Communicating Over the Same                                      | US         | ABANDONED | 14/577,769     | 12/19/14   | US 2015-0103936 A1 |            |            | 2/16/16         |
| 8303-2-CON-2-1-9   | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME                                      | US         | ISSUED    | 14/818,731     | 8/5/15     | US 2015-0341488 A1 | 9,264,533  | 2/16/16    | 1/8/21          |
| 8303-2-CON-2-1-10  | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME                                      | US         | ISSUED    | 14/991,431     | 1/8/16     | US 2016-0127537 A1 | 9,479,637  | 10/25/16   | 1/8/21          |
| 6936-2-CON-2-1-11  | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME                                      | US         | ISSUED    | 15/016,432     | 2/5/16     | US 2016-0165042 A1 | 9,973,624  | 5/15/18    | 1/8/21          |
| 6936-2-CON-2-1-12  | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME                                      | US         | ISSUED    | 15/098,932     | 4/14/16    | US 2016-0227026 A1 | 10,264,119 | 4/16/19    | 1/8/21          |
| 6936-2-CON-2-1-13  | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME                                      | US         | ISSUED    | 15/295,602     | 10/17/16   | US 2017-0034343 A1 | 9,838,531  | 12/5/17    | 1/8/21          |
| 6936-2-CON-2-1-14  | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME                                      | US         | ISSUED    | 15/958,878     | 4/20/18    | US 2018-0249001 A1 | 10,623,559 | 4/14/20    | 1/8/21          |
| 6936-2-PAU-4-DIV   | Diagnostic Methods and Systems for Multicarrier Modems                                                                                   | AU         | ISSUED    | 2008203520     | 1/8/01     | AU 2008203520      | 2008203520 | 11/5/09    | 1/8/21          |
| 6936-2-PAU-4-DIV-2 | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME                                      | AU         | ABANDONED | 2009222537     | 1/8/01     | AU 2009222537      | 2009222537 | 12/22/11   | 1/4/17          |
| 6936-2-PAU-4-DIV-3 | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME                                      | AU         | ABANDONED | 2011247879     | 1/8/01     |                    | 2011247879 | 9/18/14    | 1/4/17          |
| 6936-2-PAU-4-DIV-4 | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME                                      | AU         | ABANDONED | 2014208320     | 1/8/01     |                    | 2014208320 | 3/12/15    | 1/4/17          |
| 8303-2-PAU-4-DIV-5 | DIAGNOSTIC METHODS AND SYSTEMS FOR MULTICARRIER MODEMS                                                                                   | AU         | ABANDONED | 2015200087     | 1/8/01     |                    |            |            | 2/28/17         |
| 8303-2-PAU-4-DIV-6 | DIAGNOSTIC METHODS AND SYSTEMS FOR MULTICARRIER MODEMS                                                                                   | AU         | ABANDONED | 2017201226     | 1/8/01     |                    | 2017201226 | 9/7/17     | 12/6/19         |
| 8303-2-PAU-4-DIV-7 | DIAGNOSTIC METHODS AND SYSTEMS FOR MULTICARRIER MODEMS                                                                                   | AU         | ABANDONED | 2017210489     | 1/8/01     |                    |            |            | 12/6/19         |
| 6936-2-PCA         | Diagnostic Methods and Systems for Multicarrier Modems                                                                                   | CA         | ISSUED    | 2,394,491      | 1/8/01     | CA 2394491         | 2,394,491  | 3/29/11    | 1/8/21          |
| 6936-2-PCA-DIV     | Diagnostic Methods and Systems for Multicarrier Modems                                                                                   | CA         | ABANDONED | 2,726,826      | 1/8/01     | CA 2726826         | 2,726,826  | 11/20/12   | 12/23/16        |
| 6936-2-PCA-DIV-2   | Diagnostic Methods and Systems for Multicarrier Modems                                                                                   | CA         | EXPIRED   | 2,788,662      | 1/8/01     |                    | 2,788,662  | 1/3/17     | 1/8/20          |
| 6936-2-PCA-DIV-3   | Diagnostic Methods and Systems for Multicarrier Modems                                                                                   | CA         | ISSUED    | 2,948,960      | 1/8/01     |                    | 2,948,960  | 6/23/20    | 1/8/21          |
| 6936-2-PCT         | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME                                      | WO         | NAT PHASE | PCT/US01/00418 | 1/8/01     | WO 2001/52516      |            |            |                 |

|                       |                                                                                                     |    |           |            |        |            |            |         |          |
|-----------------------|-----------------------------------------------------------------------------------------------------|----|-----------|------------|--------|------------|------------|---------|----------|
| 6936-2-PEP-5          | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | EP | ISSUED    | 06022008.4 | 1/8/01 | 1755253    | 1755253    | 7/13/11 | 1/8/21   |
| 6936-2-PEP-5-BE       | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | BE | ISSUED    | 06022008.4 | 1/8/01 | N/A        | 1755253    | 7/13/11 | 1/8/21   |
| 6936-2-PEP-5-CH       | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | CH | ISSUED    | 06022008.4 | 1/8/01 | N/A        | 1755253    | 7/13/11 | 1/8/21   |
| 6936-2-PEP-5-DE       | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | DE | ISSUED    | 06022008.4 | 1/8/01 | N/A        | 1755253    | 7/13/11 | 1/8/21   |
| 6936-2-PEP-5-ES       | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | ES | ISSUED    | 06022008.4 | 1/8/01 | N/A        | 1755253    | 7/13/11 | 1/8/21   |
| 6936-2-PEP-5-FR       | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | FR | ISSUED    | 06022008.4 | 1/8/01 | N/A        | 1755253    | 7/13/11 | 1/8/21   |
| 6936-2-PEP-5-GB       | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | GB | ISSUED    | 06022008.4 | 1/8/01 | N/A        | 1755253    | 7/13/11 | 1/8/21   |
| 6936-2-PEP-5-GR       | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | GR | ABANDONED | 06022008.4 | 1/8/01 | N/A        | 1755253    | 7/13/11 | 12/6/19  |
| 6936-2-PEP-5-HK       | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | HK | ABANDONED | 07108499.2 | 1/8/01 | HK 1100379 |            |         | 8/4/11   |
| 6936-2-PEP-5-IE       | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | IE | ISSUED    | 06022008.4 | 1/8/01 | N/A        | 1755253    | 7/13/11 | 1/8/21   |
| 6936-2-PEP-5-IT       | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | IT | ISSUED    | 06022008.4 | 1/8/01 | N/A        | 1755253    | 7/13/11 | 1/8/21   |
| 6936-2-PEP-5-NL       | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | NL | ISSUED    | 06022008.4 | 1/8/01 | N/A        | 1755253    | 7/13/11 | 1/8/21   |
| 6936-2-PEP-5-DIV-1    | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | EP | ISSUED    | 10011985.8 | 1/8/01 | 2276182    | 2276182    | 2/26/20 | 1/8/21   |
| 6936-2-PEP-5-DIV-1-DE | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | DE | ISSUED    | 10011985.8 | 1/8/01 | 2276182    | 60151242.1 | 2/26/20 | 1/8/21   |
| 6936-2-PEP-5-DIV-1-FR | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | FR | ISSUED    | 10011985.8 | 1/8/01 |            | 2276182    | 2/26/20 | 1/8/21   |
| 6936-2-PEP-5-DIV-1-GB | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | GB | ISSUED    | 10011985.8 | 1/8/01 |            | 2276182    | 2/26/20 | 1/8/21   |
| 6936-2-PEP-5-DIV-1-HK | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | HK | ABANDONED | 11101591.8 | 1/8/01 | HK 1147612 |            |         | 12/5/19  |
| 6936-2-PEP-5-DIV-2    | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | EP | ABANDONED | 10011983.3 | 1/8/01 | 2293459    |            |         | 12/12/19 |
| 6936-2-PEP-5-DIV-2-HK | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | HK | ABANDONED | 11103980.3 | 1/8/01 | HK 1149982 |            |         | 12/12/19 |
| 6936-2-PEP-5-DIV-3    | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | EP | ISSUED    | 10011984.1 | 1/8/01 | 2317684    | 2317684    | 2/26/20 | 1/8/21   |
| 6936-2-PEP-5-DIV-3-DE | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | DE | ISSUED    | 10011984.1 | 1/8/01 | 2317684    | 60151241.3 | 2/26/20 | 1/8/21   |
| 6936-2-PEP-5-DIV-3-FR | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | FR | ISSUED    | 10011984.1 | 1/8/01 |            | 2317684    | 2/26/20 | 1/8/21   |
| 6936-2-PEP-5-DIV-3-GB | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | GB | ISSUED    | 10011984.1 | 1/8/01 |            | 2317684    | 2/26/20 | 1/8/21   |
| 6936-2-PEP-5-DIV-3-HK | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | HK | ABANDONED | 11106469.6 | 1/8/01 | 1152597    |            |         | 11/11/19 |

|                       |                                                                                                     |    |           |                |         |                    |              |          |          |
|-----------------------|-----------------------------------------------------------------------------------------------------|----|-----------|----------------|---------|--------------------|--------------|----------|----------|
| 6936-2-PEP-5-DIV-3-NL | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | NL | ISSUED    | 10011984.1     | 1/8/01  |                    | 2317684      | 2/26/20  | 1/8/21   |
| 6936-2-PEP-5-DIV-4    | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | EP | ISSUED    | 10011982.5     | 1/8/01  | 2270996            | 2270996      | 3/7/18   | 1/8/21   |
| 6936-2-PEP-5-DIV-4-DE | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | DE | ISSUED    | 10011982.5     | 1/8/01  |                    | 2270996      | 3/7/18   | 1/8/21   |
| 6936-2-PEP-5-DIV-4-FR | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | FR | ISSUED    | 10011982.5     | 1/8/01  |                    | 2270996      | 3/7/18   | 1/8/21   |
| 6936-2-PEP-5-DIV-4-GB | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | GB | ISSUED    | 10011982.5     | 1/8/01  |                    | 2270996      | 3/7/18   | 1/8/21   |
| 6936-2-PEP-5-DIV-4-HK | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | HK | ISSUED    | 11101590.0     | 1/8/01  | HK 1147611         | HK 1147611   | 9/21/18  | 1/8/21   |
| 6936-2-PEP-5-DIV-5    | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | EP | ABANDONED | 18159847.5     | 1/8/01  | 3349386            |              |          | 12/12/19 |
| 6936-2-PEP-5-DIV-5-HK | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | HK | ABANDONED | 18113502.4     | 1/8/01  | 1254420            |              |          | 1/14/20  |
| 6936-2-PIP            | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | JP | ABANDONED | 2001-552611    | 1/8/01  | JP 2003/520504     |              |          | 7/13/11  |
| 6936-2-PIP-DIV        | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | JP | ISSUED    | 2008-191051    | 1/8/01  | 2009-027721        | 4722972      | 4/15/11  | 1/8/21   |
| 6936-2-PIP-DIV-2      | SYSTEMS AND METHODS FOR ESTABLISHING A DIAGNOSTIC TRANSMISSION MODE AND COMMUNICATING OVER THE SAME | JP | ABANDONED | 2011-012155    | 1/8/01  | 2011-151808        |              |          | 6/21/13  |
| 6936-2-PROV-1         | MULTICARRIER MODULATION SYSTEM WITH REMOTE DIAGNOSTIC TRANSMISSION MODE                             | US | EXPIRED   | 60/174,865     | 1/7/00  | N/A                |              |          | 1/7/01   |
| 6936-2-PROV-2         | CHARACTERIZATION OF TRANSMISSION LINES USING BROADBAND SIGNALS IN A MULTI-CARRIER DSL SYSTEM        | US | EXPIRED   | 60/224,308     | 8/10/00 | N/A                |              |          | 8/10/01  |
| 6936-16               | SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL                                                     | US | ISSUED    | 10/264,258     | 10/4/02 | US 2003-0091053 A1 | 7,453,881    | 11/18/08 | 7/24/25  |
| 6936-16-CDN           | SYSTEMS AND METHODS FOR MULTI-PAIR OVER DSL                                                         | US | ISSUED    | 12/247,741     | 10/8/08 | US 2009-0028158 A1 | 7,809,028    | 10/5/10  | 10/4/22  |
| 6936-16-CDN-2         | Combining Multiple DSL Transceivers for a High Data Rate Connection                                 | US | ISSUED    | 12/769,277     | 4/28/10 | US 2010-0208737 A1 | 7,978,706    | 7/12/11  | 10/4/22  |
| 6936-16-CDN-3         | Systems and Methods for Multi-Pair ATM Over DSL                                                     | US | ISSUED    | 12/783,777     | 5/20/10 | US 2010-0290471 A1 | 8,422,511    | 4/16/13  | 10/4/22  |
| 6936-16-CDN-4         | Systems and Methods for Multi-Pair ATM Over DSL                                                     | US | ISSUED    | 13/863,038     | 4/15/13 | US 2013-0223453    | 8,831,031    | 9/9/14   | 10/4/22  |
| 6936-16-CDN-5         | BONDING DEVICE AND METHOD                                                                           | US | ISSUED    | 14/465,502     | 8/21/14 | US 2014-0362863 A1 | 9,014,193    | 4/21/15  | 10/4/22  |
| 6936-16-CDN-6         | BONDING DEVICE AND METHOD                                                                           | US | ISSUED    | 14/682,435     | 4/9/15  | US 2015-0215239 A1 | 9,300,601    | 3/29/16  | 10/4/22  |
| 6936-16-CDN-7         | BONDING DEVICE AND METHOD                                                                           | US | ISSUED    | 15/057,741     | 3/1/16  | US 2016-0182406 A1 | 9,894,014    | 2/13/18  | 10/4/22  |
| 6936-16-CDN-8         | BONDING DEVICE AND METHOD                                                                           | US | ISSUED    | 15/882,619     | 1/29/18 | US 2018-0152395 A1 | 10,341,261   | 7/2/19   | 10/4/22  |
| 6936-16-PCA           | SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL                                                     | CA | ISSUED    | 2,461,320      | 10/4/02 | CA 2461320         | 2,461,320    | 10/25/11 | 10/4/22  |
| 6936-16-PCT           | SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL                                                     | WO | NAT PHASE | PCT/US02/31649 | 10/4/02 | WO 2003/032555     |              |          |          |
| 6936-16-PEP           | SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL                                                     | EP | ISSUED    | 02778433.9     | 10/4/02 | 1433277            | 1433277      | 7/25/12  | 10/4/22  |
| 6936-16-PEPBE         | SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL                                                     | BE | ISSUED    | 02778433.9     | 10/4/02 |                    | 1433277      | 7/25/12  | 10/4/22  |
| 6936-16-PEPDE         | SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL                                                     | DE | ISSUED    | 02778433.9     | 10/4/02 |                    | 1433277      | 7/25/12  | 10/4/22  |
| 6936-16-PEPFR         | SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL                                                     | FR | ISSUED    | 02778433.9     | 10/4/02 |                    | 1433277      | 7/25/12  | 10/4/22  |
| 6936-16-PEPGB         | SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL                                                     | GB | ISSUED    | 02778433.9     | 10/4/02 |                    | 1433277      | 7/25/12  | 10/4/22  |
| 6936-16-PEP-DIV       | SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL                                                     | EP | ISSUED    | 12002728.9     | 10/4/02 | 2506508            | 2506508      | 5/2/18   | 10/4/22  |
| 6936-16-PEP-DIV-DE    | SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL                                                     | DE | ISSUED    | 12002728.9     | 10/4/02 |                    | 2506508      | 5/2/18   | 10/4/22  |
| 6936-16-PEP-DIV-FR    | SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL                                                     | FR | ISSUED    | 12002728.9     | 10/4/02 |                    | 2506508      | 5/2/18   | 10/4/22  |
| 6936-16-PEP-DIV-GB    | SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL                                                     | GB | ISSUED    | 12002728.9     | 10/4/02 |                    | 2506508      | 5/2/18   | 10/4/22  |
| 6936-16-PEP-DIV-2     | SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL                                                     | EP | ISSUED    | 18170134.3     | 10/4/02 | 3386128            | 3386128      | 7/24/19  | 10/4/22  |
| 6936-16-PEP-DIV-2-DE  | SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL                                                     | DE | ISSUED    | 18170134.3     | 10/4/02 | 3386128            | DE60249960.7 | 7/24/19  | 10/4/22  |
| 6936-16-PEP-DIV-2-FR  | SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL                                                     | FR | ISSUED    | 18170134.3     | 10/4/02 |                    | 3386128      | 7/24/19  | 10/4/22  |
| 6936-16-PEP-DIV-2-GB  | SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL                                                     | GB | ISSUED    | 18170134.3     | 10/4/02 |                    | 3386128      | 7/24/19  | 10/4/22  |

|                      |                                                                                                     |    |           |                 |          |                    |                  |          |          |
|----------------------|-----------------------------------------------------------------------------------------------------|----|-----------|-----------------|----------|--------------------|------------------|----------|----------|
| 6936-16-PEP-DIV-2-NL | SYSTEMS AND METHODS FOR MULTI-PAIR ATM OVER DSL                                                     | NL | ISSUED    | 18170134.3      | 10/4/02  |                    | 3386128          | 7/24/19  | 10/4/22  |
| 6936-16-PROV         | MULTI-PAIR ATM OVER DSL                                                                             | US | EXPIRED   | 60/327,440      | 10/5/01  | N/A                |                  |          | 10/5/02  |
| 6936-54              | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | US | ISSUED    | 11/246,163      | 10/11/05 | US 2006-0088054 A1 | 7,831,890        | 11/9/10  | 11/7/28  |
| 6936-54-CDN          | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | US | ISSUED    | 12/761,586      | 4/16/10  | US 2010-0228924 A1 | 7,844,882        | 11/30/10 | 10/11/25 |
| 6936-54-CDN-2        | Computer Readable Medium with Instructions for Resource Sharing in a Telecommunications Environment | US | ISSUED    | 12/853,020      | 8/9/10   | US 2010-0306628 A1 | 7,836,381        | 11/16/10 | 10/11/25 |
| 6936-54-CDN-3        | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | US | ISSUED    | 12/901,699      | 10/11/10 | US 2011-0029844 A1 | 8,276,048        | 9/25/12  | 10/11/25 |
| 6936-54-CDN-4        | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | US | ISSUED    | 13/567,261      | 8/6/12   | US 2012-0297148 A1 | 8,495,473        | 7/23/13  | 10/11/25 |
| 6936-54-CDN-5        | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | US | ISSUED    | 13/942,938      | 7/16/13  | US 2013-0308689 A1 | 8,607,126        | 12/10/13 | 10/11/25 |
| 6936-54-CDN-6        | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | US | ISSUED    | 14/081,469      | 11/15/13 | US 2014-0075128 A1 | 9,069,718        | 6/30/15  | 10/11/25 |
| 6936-54-CDN-7        | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | US | ISSUED    | 14/730,874      | 6/4/15   | US 2015-0268863 A1 | 9,286,251        | 3/15/16  | 10/11/25 |
| 6936-54-CDN-8        | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | US | ISSUED    | 15/046,821      | 2/18/16  | US 2016-0179389 A1 | 9,547,608        | 1/17/17  | 10/11/25 |
| 6936-54-CDN-9        | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | US | ISSUED    | 15/372,841      | 12/8/16  | US 2017-0090811 A1 | 9,898,220        | 2/20/18  | 10/11/25 |
| 6936-54-CDN-10       | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | US | ISSUED    | 15/874,277      | 1/18/18  | US 2018-0157436 A1 | 10,409,510       | 9/10/19  | 10/11/25 |
| 6936-54-CDN-10-DIV   | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | US | ISSUED    | 16/261,109      | 1/29/19  | US 2019-0155530 A1 | 10,579,291       | 3/3/20   | 10/11/25 |
| 6936-54-CDN-11       | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | US | PUBLISHED | 16/544,003      | 8/19/19  | US 2019-0369891 A1 |                  |          | 10/11/25 |
| 6936-54-PAU          | Resource Sharing in a Telecommunications Environment                                                | AU | ABANDONED | 2005296086      | 10/11/05 | AU 2005296086      |                  |          | 4/6/11   |
| 6936-54-PAU-DIV      | Resource Sharing in a Telecommunications Environment                                                | AU | ABANDONED | 2011201250      | 10/11/05 | AU 2011201250      |                  |          | 2/23/15  |
| 6936-54-PAU-DIV-2    | Resource Sharing in a Telecommunications Environment                                                | AU | ISSUED    | 2015200618      | 10/11/05 |                    | 2015200618       | 11/12/15 | 10/11/25 |
| 6936-54-PCA          | Resource Sharing in a Telecommunications Environment                                                | CA | ISSUED    | 2,580,280       | 10/11/05 | CA 2580280         | 2,580,280        | 3/10/15  | 10/11/25 |
| 6936-54-PCA-DIV      | Resource Sharing in a Telecommunications Environment                                                | CA | ABANDONED | 2,869,452       | 10/11/05 |                    | 2,869,452        | 1/19/16  | 9/25/17  |
| 6936-54-PCA-DIV-2    | Resource Sharing in a Telecommunications Environment                                                | CA | ABANDONED | 2,909,150       | 10/11/05 |                    | 2,909,150        | 11/7/17  | 9/4/20   |
| 6936-54-PCA-DIV-3    | Resource Sharing in a Telecommunications Environment                                                | CA | ISSUED    | 2,980,607       | 10/11/05 |                    | 2,980,607        | 4/7/20   | 10/11/25 |
| 6936-54-PCN          | Resource Sharing in a Telecommunications Environment                                                | CN | ABANDONED | 200580032703.1  | 10/11/05 | CN101057438A       |                  |          | 7/14/15  |
| 6936-54-PCN-DIV      | Resource Sharing in a Telecommunications Environment                                                | CN | ISSUED    | 201510413116.2  | 10/11/05 | 104993912          | ZL201510413116.2 | 12/3/19  | 10/11/25 |
| 6936-54-PCT          | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | WO | NAT PHASE | PCT/US05/36015  | 10/11/05 | WO 2006/044227 A1  |                  |          |          |
| 6936-54-PEP          | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | EP | ISSUED    | 05807443.6      | 10/11/05 | EP 1832028         | 1832028          | 1/31/18  | 10/11/25 |
| 6936-54-PEPDE        | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | DE | ISSUED    | 05807443.6      | 10/11/05 |                    | 1832028          | 1/31/18  | 10/11/25 |
| 6936-54-PEPFR        | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | FR | ISSUED    | 05807443.6      | 10/11/05 |                    | 1832028          | 1/31/18  | 10/11/25 |
| 6936-54-PEPGB        | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | GB | ISSUED    | 05807443.6      | 10/11/05 |                    | 1832028          | 1/31/18  | 10/11/25 |
| 6936-54-PEPHK        | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | HK | ISSUED    | 07110121.4      | 10/11/05 | HK 1102043         | HK 1102043       | 7/6/18   | 10/11/25 |
| 6936-54-PEP-DIV      | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | EP | PUBLISHED | 18153945.3      | 10/11/05 | 3340511            |                  |          | 10/11/25 |
| 6936-54-PEP-DIV-HK   | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | HK | PUBLISHED | 18113503.3      | 10/11/05 | 1254421            |                  |          | 10/11/25 |
| 6936-54-PIN          | Resource Sharing in a Telecommunications Environment                                                | IN | ABANDONED | 1208/KOLNP/2007 | 10/11/05 | IN 1208/KOLNP/2007 |                  |          | 10/12/24 |
| 6936-54-PIP          | Resource Sharing in a Telecommunications Environment                                                | JP | ISSUED    | 2007-533818     | 10/11/05 | 2008-516533        | 4889646          | 12/22/11 | 10/11/25 |
| 6936-54-PIP-DIV      | Resource Sharing in a Telecommunications Environment                                                | JP | ABANDONED | 2008-264540     | 10/11/05 | 2009-065692        | 4976359          | 4/20/12  | 2/21/17  |
| 6936-54-PKR          | Method and System for Allocating Shared Memory in a Transceiver                                     | KR | ISSUED    | 10-2007-7008270 | 10/11/05 | 10-2007-0065369    | 10-1160717       | 6/21/12  | 10/11/25 |
| 6936-54-PKR-DIV      | Method for Allocating Memory in a Transceiver                                                       | KR | ABANDONED | 10-2010-7022463 | 10/11/05 | 10-2010/0116234    | 10-1160765       | 6/21/12  | 3/10/17  |
| 6936-54-PROV         | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT                                                | US | EXPIRED   | 60/618,269      | 10/12/04 | N/A                |                  |          | 10/12/05 |

|                       |                                                                                                      |    |           |                 |          |                    |            |          |          |
|-----------------------|------------------------------------------------------------------------------------------------------|----|-----------|-----------------|----------|--------------------|------------|----------|----------|
| 6936-47               | SYSTEM AND METHOD FOR SCRAMBLING THE PHASE OF THE CARRIERS IN A MULTICARRIER COMMUNICATIONS SYSTEM   | US | ISSUED    | 09/710,310      | 11/9/00  | N/A                | 6,961,369  | 11/1/05  | 7/28/23  |
| 6936-47-CDN           | SYSTEM AND METHOD FOR SCRAMBLING THE PHASE OF THE CARRIERS IN A MULTICARRIER COMMUNICATIONS SYSTEM   | US | EXPIRED   | 11/211,535      | 8/26/05  | US 2006-0002454 A1 | 7,292,627  | 11/6/07  | 11/9/20  |
| 6936-47-CDN-2         | System and Method for Scrambling the Phase of the Carriers in a Multicarrier Communications System   | US | EXPIRED   | 11/863,581      | 9/28/07  | US 2008-0069253 A1 | 7,471,721  | 12/30/08 | 11/9/20  |
| 6936-47-CDN-3         | System and Method for Scrambling the Phase of the Carriers in a Multicarrier Communications System   | US | EXPIRED   | 12/255,713      | 10/22/08 | US 2009-0110105 A1 | 7,769,104  | 8/3/10   | 11/9/20  |
| 6936-47-CDN-4         | System and Method for Scrambling the Phase of the Carriers in a Multicarrier Communications System   | US | EXPIRED   | 12/783,725      | 5/20/10  | US 2010-0290507 A1 | 8,090,008  | 1/3/12   | 11/9/20  |
| 6936-47-CDN-5         | System and Method for Scrambling the Phase of the Carriers in a Multicarrier Communications System   | US | EXPIRED   | 13/303,417      | 11/23/11 | US 2012-0069878 A1 | 8,718,138  | 5/6/14   | 11/18/20 |
| 6936-47-CDN-6         | System and Method for Scrambling the Phase of the Carriers in a Multicarrier Communications System   | US | EXPIRED   | 14/256,677      | 4/18/14  | US 2014-0226737 A1 | 8,929,470  | 1/6/15   | 11/9/20  |
| 6936-47-CDN-7         | System and Method for Scrambling the Phase of the Carriers in a Multicarrier Communications System   | US | EXPIRED   | 14/540,332      | 11/13/14 | US 2015-0071385 A1 | 9,755,876  | 9/3/17   | 11/9/20  |
| 6936-47-CDN-8         | System and Method for Scrambling the Phase of the Carriers in a Multicarrier Communications System   | US | EXPIRED   | 15/693,914      | 9/1/17   | US 2018-0013599 A1 | 10,187,240 | 1/22/19  | 11/9/20  |
| 6936-47-CDN-DIV       | System and Method for Descrambling the Phase of the Carriers in a Multicarrier Communications System | US | ISSUED    | 11/860,080      | 9/24/07  |                    | 8,073,041  | 12/6/11  | 11/5/23  |
| 6936-47-CDN-DIV-CON   | System and method for descrambling the phase of carriers in a multicarrier communications system     | US | EXPIRED   | 13/284,549      | 10/28/11 | US 2012-0044977 A1 | 8,218,610  | 7/10/12  | 11/9/20  |
| 6936-47-CDN-DIV-CON-2 | System and Method for Descrambling the Phase of Carriers in a Multicarrier Communications System     | US | EXPIRED   | 13/439,605      | 4/4/12   | US 2012-0195353 A1 | 8,355,427  | 1/15/13  | 11/9/20  |
| 6936-47-CDN-DIV-CON-3 | System and Method for Scrambling Using a Bit Scrambler and a Phase Scrambler                         | US | EXPIRED   | 13/718,016      | 12/18/12 | US 2013-0136160-A1 | 9,014,243  | 4/21/15  | 11/9/20  |
| 6936-47-CDN-DIV-CON-4 | SYSTEM AND METHOD FOR SCRAMBLING USING A BIT SCRAMBLER AND A PHASE SCRAMBLER                         | US | EXPIRED   | 14/684,737      | 4/13/15  | US 2015-0222467 A1 | 9,485,128  | 11/1/16  | 11/9/20  |
| 6936-47-CDN-DIV-CON-5 | SYSTEM AND METHOD FOR SCRAMBLING USING A BIT SCRAMBLER AND A PHASE SCRAMBLER                         | US | PUBISHED  | 15/298,817      | 10/20/16 | US 2017-0041173 A1 |            |          | 11/9/20  |
| 6936-47-PAU           | SYSTEM AND METHOD FOR SCRAMBLING THE PHASE OF THE CARRIERS IN A MULTICARRIER COMMUNICATIONS SYSTEM   | AU | ABANDONED | 13964/01        | 11/9/00  | AU 1596401         |            |          | 11/9/20  |
| 6936-47-PCA           | SYSTEM AND METHOD FOR SCRAMBLING THE PHASE OF THE CARRIERS IN A MULTICARRIER COMMUNICATIONS SYSTEM   | CA | ABANDONED | 2,387,812       | 11/9/00  | CA2387812          |            |          | 11/9/20  |
| 6936-47-PCT           | SYSTEM AND METHOD FOR SCRAMBLING THE PHASE OF THE CARRIERS IN A MULTICARRIER COMMUNICATIONS SYSTEM   | WO | NAT PHASE | PCT/US00/030958 | 11/9/00  | WO 2001/035591     |            |          |          |
| 6936-47-PEP           | SYSTEM AND METHOD FOR SCRAMBLING THE PHASE OF THE CARRIERS IN A MULTICARRIER COMMUNICATIONS SYSTEM   | EP | ABANDONED | 00978507.2      | 11/9/00  | EP 1228615         |            |          | 11/9/20  |
| 6936-47-PPP           | SYSTEM AND METHOD FOR SCRAMBLING THE PHASE OF THE CARRIERS IN A MULTICARRIER COMMUNICATIONS SYSTEM   | JP | ABANDONED | 2001-537217     | 11/9/00  | 2003-514444A       |            |          | 11/9/20  |
| 6936-47-PPP-DIV       | System and Method for Scrambling the Phase of the Carriers in a Multicarrier Communications System   | JP | ABANDONED | 2006-345675     | 11/9/00  | JP 2007/129755     |            |          | 11/9/20  |
| 6936-47-PKR           | SYSTEM AND METHOD FOR SCRAMBLING THE PHASE OF THE CARRIERS IN A MULTICARRIER COMMUNICATIONS SYSTEM   | KR | ABANDONED | 2002-7005830    | 11/9/00  | 10-2002-0049025    |            |          | 11/9/20  |
| 6936-47-PROV          | SYSTEM AND METHOD FOR SCRAMBLING THE PHASE OF THE CARRIERS IN A MULTICARRIER COMMUNICATIONS SYSTEM   | US | EXPIRED   | 60/164,134      | 11/9/99  | N/A                |            |          | 11/9/00  |
| 6936-53               | CRC COUNTER NORMALIZATION                                                                            | US | ISSUED    | 11/232,899      | 9/23/05  | US 2006-0069980 A1 | 7,451,379  | 11/11/08 | 3/8/27   |
| 6936-53-CDN           | CRC COUNTER NORMALIZATION                                                                            | US | ISSUED    | 12/236,902      | 9/24/08  | US 2009-0019346    | 7,925,958  | 4/12/11  | 5/4/26   |
| 6936-53-CDN-2         | CRC COUNTER NORMALIZATION                                                                            | US | ISSUED    | 12/783,771      | 5/20/10  | US 2010-0293444 A1 | 7,979,778  | 7/12/11  | 9/23/25  |
| 6936-53-CDN-3         | CRC COUNTER NORMALIZATION                                                                            | US | ISSUED    | 13/156,098      | 6/8/11   | US 2011-0239087 A1 | 8,516,337  | 8/20/13  | 9/23/25  |
| 6936-53-CDN-4         | CRC COUNTER NORMALIZATION                                                                            | US | ISSUED    | 13/968,880      | 8/16/13  | US 2013-0339828 A1 | 8,793,553  | 7/29/14  | 9/23/25  |
| 6936-53-CDN-5         | CRC COUNTER NORMALIZATION                                                                            | US | ISSUED    | 14/338,503      | 7/23/14  | US 2014-0337683 A1 | 8,984,366  | 3/17/15  | 9/23/25  |
| 6936-53-CDN-6         | CRC COUNTER NORMALIZATION                                                                            | US | ISSUED    | 14/638,889      | 3/4/15   | US 2015-0180508 A1 | 9,300,324  | 3/29/16  | 9/23/25  |
| 6936-53-CDN-7         | CRC COUNTER NORMALIZATION                                                                            | US | ISSUED    | 15/062,522      | 3/7/16   | US 2016-0188403 A1 | 10,049,003 | 8/14/18  | 9/23/25  |
| 6936-53-CDN-8         | CRC COUNTER NORMALIZATION                                                                            | US | ISSUED    | 16/037,825      | 7/17/18  | US 2018-0341544 A1 | 10,346,243 | 7/9/19   | 9/23/25  |
| 6936-53-CDN-9         | CRC COUNTER NORMALIZATION                                                                            | US | PUBISHED  | 16/428,232      | 5/31/19  | US 2019-0286514 A1 |            |          | 9/23/25  |
| 6936-53-PAU           | CRC COUNTER NORMALIZATION                                                                            | AU | ISSUED    | 2005289753      | 9/23/05  | AU 2005289753      | 2005289753 | 3/19/09  | 9/23/25  |
| 6936-53-PAU-DIV       | CRC COUNTER NORMALIZATION                                                                            | AU | ABANDONED | 2009200784      | 9/23/05  | AU 2009200784      |            |          | 6/27/11  |
| 6936-53-PCA           | CRC COUNTER NORMALIZATION                                                                            | CA | ISSUED    | 2,550,263       | 9/23/05  | CA 2550263         | 2,550,263  | 11/2/10  | 9/23/25  |



|                       |                                                                                                                               |    |           |                 |          |                    |                |          |          |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------|----|-----------|-----------------|----------|--------------------|----------------|----------|----------|
| 6936-53-PCA-DIV       | CRC COUNTER NORMALIZATION                                                                                                     | CA | ABANDONED | 2,711,718       | 9/23/05  | CA 2711718         | 2,711,718      | 3/24/15  | 7/28/20  |
| 6936-53-PCA-DIV-2     | CRC COUNTER NORMALIZATION                                                                                                     | CA | ABANDONED | 2,876,137       | 9/23/05  |                    | 2,876,137      | 9/13/16  | 9/12/18  |
| 6936-53-PCA-DIV-3     | CRC COUNTER NORMALIZATION                                                                                                     | CA | ABANDONED | 2,935,980       | 9/23/05  |                    | 2,935,980      | 1/8/19   | 7/28/20  |
| 6936-53-PCA-DIV-4     | CRC COUNTER NORMALIZATION                                                                                                     | CA | ABANDONED | 3,023,907       | 9/23/05  |                    | 3,023,907      | 6/4/19   | 7/28/20  |
| 6936-53-PCN           | CRC COUNTER NORMALIZATION                                                                                                     | CN | ISSUED    | 200580008869.X  | 9/23/05  | CN1934817A         | 200580008869.X | 5/16/12  | 9/23/25  |
| 6936-53-PCN-DIV       | CRC COUNTER NORMALIZATION                                                                                                     | CN | ABANDONED | 201210063701.0  | 9/23/05  | CN 102624488       | 201210063701.0 | 11/25/15 | 7/25/17  |
| 6936-53-PCN-DIV-HK    | A Method and a system for Cyclic Redundancy Checksum (CRC) Anomaly Counter Normalization, and a Module Performing the Method. | HK | ABANDONED | 13101408.9      | 9/23/05  | HK1174752          |                |          | 3/22/16  |
| 6936-53-PCT           | CRC COUNTER NORMALIZATION                                                                                                     | WO | NAT PHASE | PCT/US05/03922  | 9/23/05  | WO 2006/036723 A1  |                |          |          |
| 6936-53-PEP           | CRC COUNTER NORMALIZATION                                                                                                     | EP | ISSUED    | 05799765.2      | 9/23/05  | 1792430            | 1792430        | 7/20/11  | 9/23/25  |
| 6936-53-PEPBE         | CRC COUNTER NORMALIZATION                                                                                                     | BE | ABANDONED | 05799765.2      | 9/23/05  | N/A                | 1792430        | 7/20/11  | 8/4/20   |
| 6936-53-PEPCH         | CRC COUNTER NORMALIZATION                                                                                                     | CH | ABANDONED | 05799765.2      | 9/23/05  | N/A                | 1792430        | 7/20/11  | 8/4/20   |
| 6936-53-PEPDE         | CRC COUNTER NORMALIZATION                                                                                                     | DE | ISSUED    | 05799765.2      | 9/23/05  | N/A                | 1792430        | 7/20/11  | 9/23/25  |
| 6936-53-PEPDK         | CRC COUNTER NORMALIZATION                                                                                                     | DK | ABANDONED | 05799765.2      | 9/23/05  | N/A                | 1792430        | 7/20/11  | 8/4/20   |
| 6936-53-PEPFR         | CRC COUNTER NORMALIZATION                                                                                                     | FR | ISSUED    | 05799765.2      | 9/23/05  | N/A                | 1792430        | 7/20/11  | 9/23/25  |
| 6936-53-PEPGB         | CRC COUNTER NORMALIZATION                                                                                                     | GB | ABANDONED | 05799765.2      | 9/23/05  | N/A                | 1792430        | 7/20/11  | 8/6/19   |
| 6936-53-PEPHK         | CRC COUNTER NORMALIZATION                                                                                                     | HK | ABANDONED | 07110654.9      | 9/23/05  | HK 1102488         |                |          | 8/4/11   |
| 6936-53-PEPIE         | CRC COUNTER NORMALIZATION                                                                                                     | IE | ABANDONED | 05799765.2      | 9/23/05  | N/A                | 1792430        | 7/20/11  | 8/4/20   |
| 6936-53-PEPINL        | CRC COUNTER NORMALIZATION                                                                                                     | NL | ISSUED    | 05799765.2      | 9/23/05  | N/A                | 1792430        | 7/20/11  | 9/23/25  |
| 6936-53-PEPSE         | CRC COUNTER NORMALIZATION                                                                                                     | SE | ABANDONED | 05799765.2      | 9/23/05  | N/A                | 1792430        | 7/20/11  | 8/4/20   |
| 6936-53-PEP-DIV       | CRC COUNTER NORMALIZATION                                                                                                     | EP | ISSUED    | 11005906.0      | 9/23/05  | EP2381610A1        | 2381610        | 12/21/16 | 9/23/25  |
| 6936-53-PEP-DIV-DE    | CRC COUNTER NORMALIZATION                                                                                                     | DE | ISSUED    | 11005906.0      | 9/23/05  |                    | 2381610        | 12/21/16 | 9/23/25  |
| 6936-53-PEP-DIV-FR    | CRC COUNTER NORMALIZATION                                                                                                     | FR | ISSUED    | 11005906.0      | 9/23/05  |                    | 2381610        | 12/21/16 | 9/23/25  |
| 6936-53-PEP-DIV-GB    | CRC COUNTER NORMALIZATION                                                                                                     | GB | ISSUED    | 11005906.0      | 9/23/05  |                    | 2381610        | 12/21/16 | 9/23/25  |
| 6936-53-PEP-DIV-2     | CRC COUNTER NORMALIZATION                                                                                                     | EP | ISSUED    | 16020487.1      | 9/23/05  | 3176973            | 3176973        | 6/17/20  | 9/23/25  |
| 6936-53-PEP-DIV-2-DE  | CRC COUNTER NORMALIZATION                                                                                                     | DE | ISSUED    | 16020487.1      | 9/23/05  |                    | 3176973        | 6/17/20  | 9/23/25  |
| 6936-53-PEP-DIV-2-FR  | CRC COUNTER NORMALIZATION                                                                                                     | FR | ISSUED    | 16020487.1      | 9/23/05  |                    | 3176973        | 6/17/20  | 9/23/25  |
| 6936-53-PEP-DIV-2-GB  | CRC COUNTER NORMALIZATION                                                                                                     | GB | ISSUED    | 16020487.1      | 9/23/05  |                    | 3176973        | 6/17/20  | 9/23/25  |
| 6936-52-PIN           | CRC COUNTER NORMALIZATION                                                                                                     | IN | ABANDONED | 1601/KOLNP/2006 | 9/23/05  | IN 1601/KOLNP/2006 |                |          | 9/23/25  |
| 6936-53-PJP           | CRC COUNTER NORMALIZATION                                                                                                     | JP | ABANDONED | 2006-551651     | 9/23/05  | 2007-519382        |                |          | 10/12/11 |
| 6936-53-PJP-DIV       | CRC COUNTER NORMALIZATION                                                                                                     | JP | ABANDONED | 2006-345676     | 9/23/05  | JP 2007/151145     |                |          | 10/12/11 |
| 6936-53-PJP-DIV-2     | CRC COUNTER NORMALIZATION                                                                                                     | JP | ISSUED    | 2010-042193     | 9/23/05  | 2010-178353        | 5237317        | 4/5/13   | 9/23/25  |
| 6936-53-PJP-DIV-3     | CRC COUNTER NORMALIZATION                                                                                                     | JP | ISSUED    | 2012-194723     | 9/23/05  | 2013-009417        | 3823936        | 10/16/15 | 9/23/25  |
| 6936-53-PJP-DIV-4     | CRC COUNTER NORMALIZATION                                                                                                     | JP | ISSUED    | 2015-105633     | 9/23/05  | 2015-167401        | 6215254        | 9/29/17  | 9/23/25  |
| 6936-53-PJP-DIV-5     | CRC COUNTER NORMALIZATION                                                                                                     | JP | ISSUED    | 2016-162059     | 9/23/05  | 2016-220241        | 6335230        | 5/11/18  | 9/23/25  |
| 6936-53-PKR           | CRC COUNTER NORMALIZATION                                                                                                     | KR | ISSUED    | 10-2006-7011697 | 9/23/05  | 10-2007-0072425    | 10-0955190     | 4/20/10  | 9/23/25  |
| 6936-53-PKR-DIV       | CRC COUNTER NORMALIZATION                                                                                                     | KR | ABANDONED | 10-2010-7005285 | 9/23/05  | 10-2010/0035665    |                |          | 9/23/25  |
| 6936-53-PKR-DIV-2     | CRC COUNTER NORMALIZATION                                                                                                     | KR | ABANDONED | 10-2010-7024190 | 9/23/05  | 10-2010-0120722    |                |          | 9/23/25  |
| 6936-53-PROV          | CRC COUNTER NORMALIZATION METHOD AND SYSTEM                                                                                   | US | EXPIRE    | 60/613,594      | 9/25/04  | N/A                |                |          | 9/25/05  |
| 6936-52-PCA           | Impulse Noise Management                                                                                                      | CA | ISSUED    | 2,555,757       | 3/3/05   | CA 2555757         | 2,555,757      | 1/20/15  | 3/3/25   |
| 6936-52-PCA-REI       | Impulse Noise Management                                                                                                      | CA | ISSUED    | 2,555,757R      | 3/3/05   |                    | 2,555,757      | 3/27/18  | 3/3/25   |
| 6936-52-PCN           | On-Line Impulse Noise Protection (INP) Adaptation                                                                             | CN | ABANDONED | 200580006738.8  | 3/3/05   | CN1926794A         |                |          | 11/10/11 |
| 6936-52-PCT           | ON-LINE IMPULSE NOISE PROTECTION (INP) ADAPTATION                                                                             | WO | NAT PHASE | PCT/US05/06842  | 3/3/05   | WO 2005/086405 A3  |                |          |          |
| 6936-52-PEP           | Impulse Noise Management                                                                                                      | EP | ABANDONED | 05724394.1      | 3/3/05   | EP 1721403         |                |          | 3/3/25   |
| 6936-52-PEPHK         | ON-LINE IMPULSE NOISE PROTECTION (INP) ADAPTATION                                                                             | HK | ABANDONED | 07105044.1      | 3/3/05   | HK 1097672         |                |          | 8/23/12  |
| 6936-52-PEP-DIV       | Impulse Noise Management                                                                                                      | EP | ABANDONED | 10006702.4      | 3/3/05   | 2228936            |                |          | 3/7/11   |
| 6936-52-PEP-DIV-HK    | Impulse Noise Management                                                                                                      | HK | ABANDONED | 10110020.1      | 3/3/05   | HK 1143672         |                |          | 8/23/12  |
| 6936-52-PIN           | ON-LINE IMPULSE NOISE PROTECTION (INP) ADAPTATION                                                                             | IN | ABANDONED | 2155/KOLNP/2006 | 7/31/06  | IN 2137/KOLNP/2006 |                |          | 7/31/26  |
| 6936-52-PROV          | ON-LINE IMPULSE NOISE PROTECTION (INP) ADAPTATION                                                                             | US | EXPIRE    | 60/549,804      | 3/3/04   | N/A                |                |          | 3/3/05   |
| 6936-52-PROV-2        | IMPULSE NOISE PROTECTION (INP) TRAINING                                                                                       | US | EXPIRE    | 60/555,982      | 3/24/04  | N/A                |                |          | 3/24/05  |
| 6936-52-PUS           | Impulse Noise Management                                                                                                      | US | ABANDONED | 10/597,482      | 7/27/06  | US 2008-0232444 A1 |                |          | 10/14/11 |
| 6936-52-PUS-CON       | Impulse Noise Management                                                                                                      | US | ISSUED    | 12/769,193      | 4/28/10  | US 2010-0220771 A1 | 8,462,835      | 6/11/13  | 3/3/25   |
| 6936-52-PUS-CON-2     | Impulse Noise Management                                                                                                      | US | ISSUED    | 13/914,852      | 6/11/13  | US 2013-0272355 A1 | 8,594,162      | 11/26/13 | 3/3/25   |
| 6936-52-PUS-CON-3     | Impulse Noise Management                                                                                                      | US | ISSUED    | 14/075,077      | 11/8/13  | US 2014-0064343 A1 | 8,743,932      | 6/3/14   | 3/3/25   |
| 6936-52-PUS-CON-4     | Impulse Noise Management                                                                                                      | US | ABANDONED | 14/285,911      | 5/23/14  | US 2014-0254643 A1 |                |          | 2/11/16  |
| 6936-52-PUS-CON-5     | IMPULSE NOISE MANAGEMENT                                                                                                      | US | ABANDONED | 14/757,630      | 12/23/15 | US 2016-0127079 A1 |                |          | 9/10/18  |
| 6936-52-PUS-CON-6     | IMPULSE NOISE MANAGEMENT                                                                                                      | US | ISSUED    | 16/126,027      | 9/10/18  | US 2019-0007164 A1 | 10,567,112     | 2/18/20  | 3/3/25   |
| 6936-52-PUS-CON-6-DIV | IMPULSE NOISE MANAGEMENT                                                                                                      | US | ISSUED    | 16/448,939      | 6/21/19  | US 2019-0312667 A1 | 10,805,040     | 10/13/20 | 3/3/25   |
| 6936-52-PUS-CON-7     | IMPULSE NOISE MANAGEMENT                                                                                                      | US | PUBLISHED | 16/781,802      | 2/4/20   | US 2020-0177304 A1 |                |          | 3/3/25   |
| 6936-28               | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY                                            | US | EXPIRE    | 09/581,400      | 6/13/00  | N/A                | 6,445,730      | 9/3/02   | 1/26/19  |
| 6936-28-CON           | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY                                            | US | ABANDONED | 10/175,815      | 6/21/02  | US 2002-0150152    |                |          | 5/17/04  |
| 6936-28-CON-1         | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY                                            | US | ABANDONED | 10/778,083      | 2/17/04  | US 2004-0160906    |                |          | 5/30/05  |
| 6936-28-CON-2         | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY                                            | US | ABANDONED | 11/090,183      | 3/28/05  | US 2005-0185726 A1 |                |          | 3/12/06  |
| 6936-28-CON-3         | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY                                            | US | ABANDONED | 11/285,516      | 11/30/05 | US 2006-0078060 A1 |                |          |          |

|                        |                                                                                    |    |           |                |          |                    |           |          |          |
|------------------------|------------------------------------------------------------------------------------|----|-----------|----------------|----------|--------------------|-----------|----------|----------|
| 6936-28-CD-N-4         | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY | US | EXPIRED   | 11/425,507     | 6/21/06  | US 2006-0233273 A1 | 7,697,598 | 4/13/10  | 1/26/19  |
| 6936-28-CD-N-5         | Multicarrier Transmission System with Low Power Sleep Mode and Rapid-on Capability | US | ABANDONED | 12/615,946     | 11/10/09 | US 2010-0054312 A1 | 7,978,753 | 7/12/11  | 12/12/18 |
| 6936-28-CD-N-6         | Multicarrier Transmission System with Low Power Sleep Mode and Rapid-On Capability | US | EXPIRED   | 13/152,558     | 6/3/11   | US 2011-0235691 A1 | 8,437,382 | 5/7/13   | 1/26/19  |
| 6936-28-CD-N-7         | Multicarrier Transmission System with Low Power Sleep Mode and Rapid-On Capability | US | EXPIRED   | 13/887,889     | 5/6/13   | US 2013-0243051-A1 | 8,611,404 | 12/17/13 | 1/26/19  |
| 6936-28-CD-N-8         | Multicarrier Transmission System with Low Power Sleep Mode and Rapid-On Capability | US | EXPIRED   | 14/092,248     | 11/27/13 | US 2014-0086287 A1 | 8,750,352 | 6/10/14  | 1/26/19  |
| 6936-28-CD-N-9         | Multicarrier Transmission System with Low Power Sleep Mode and Rapid-On Capability | US | ABANDONED | 14/295,981     | 6/4/14   | US 2014-0286379 A1 | 9,094,268 | 7/28/15  | 12/12/18 |
| 6936-28-CD-N-10        | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY | US | EXPIRED   | 14/798,014     | 7/13/15  | US 2015-0326404 A1 | 9,521,003 | 12/13/16 | 1/26/19  |
| 6936-28-CD-N-11        | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY | US | ABANDONED | 15/180,274     | 6/13/16  | US 2016-0286493 A1 |           |          | 11/19/18 |
| 6936-28-PAU            | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY | AU | EXPIRED   | 23409/99       | 1/26/99  | AU 2340999         | 764933    | 12/18/03 | 1/26/19  |
| 6936-28-PAU-2          | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY | AU | ABANDONED | 2003266426     | 12/4/03  | AU 2003266429      |           |          | 3/10/05  |
| 6936-28-PCA            | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY | CA | EXPIRED   | 2,357,551      | 1/26/99  | CA 2357551         | 2,357,551 | 9/30/08  | 1/26/19  |
| 6936-28-PCA-DIV        | Multicarrier Transmission System With Low Power Sleep Mode and Rapid-On Capability | CA | ABANDONED | 2,633,064      | 1/26/99  | CA 2633064         | 2,633,064 | 4/2/13   | 12/23/16 |
| 6936-28-PCA-DIV-2      | Multicarrier Transmission System With Low Power Sleep Mode and Rapid-On Capability | CA | EXPIRED   | 2,800,005      | 1/26/99  |                    | 2,800,005 | 3/14/17  | 1/26/19  |
| 6936-28-PCT            | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY | WO | NAT PHASE | PCT/US99/01339 | 1/26/99  | WO 2000/045559     |           |          |          |
| 6936-28-PEP            | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY | EP | EXPIRED   | 99903370.7     | 1/26/99  | 1145518            | 1145518   | 11/24/04 | 1/26/19  |
| 6936-28-PEPGB          | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY | GB | EXPIRED   | 99903370.7     | 1/26/99  | N/A                | 1145518   | 11/24/04 | 1/26/19  |
| 6936-28-PEP-2          | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY | EP | EXPIRED   | 04022871.0     | 1/26/99  | 1524812            | 1524812   | 10/31/07 | 1/26/19  |
| 6936-28-PEP-2-DE       | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY | DE | EXPIRED   | 04022871.0     | 1/26/99  | N/A                | 1524812   | 10/31/07 | 1/26/19  |
| 6936-28-PEP-2-FR       | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY | FR | EXPIRED   | 04022871.0     | 1/26/99  | N/A                | 1524812   | 10/31/07 | 1/26/19  |
| 6936-28-PEP-2-GB       | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY | GB | EXPIRED   | 04022871.0     | 1/26/99  | N/A                | 1524812   | 10/31/07 | 1/26/19  |
| 6936-28-PEP-3          | Multicarrier Transmission System with Low Power Sleep Mode and Rapid-on-Capability | EP | EXPIRED   | 07021150.3     | 1/26/99  | 1901512            | 1901512   | 11/23/11 | 1/26/19  |
| 6936-28-PEP-3-DE       | Multicarrier Transmission System with Low Power Sleep Mode and Rapid-on-Capability | DE | EXPIRED   | 07021150.3     | 1/26/99  | N/A                | 1901512   | 11/23/11 | 1/26/19  |
| 6936-28-PEP-3-FR       | Multicarrier Transmission System with Low Power Sleep Mode and Rapid-on-Capability | FR | EXPIRED   | 07021150.3     | 1/26/99  | N/A                | 1901512   | 11/23/11 | 1/26/19  |
| 6936-28-PEP-3-GB       | Multicarrier Transmission System with Low Power Sleep Mode and Rapid-on-Capability | GB | EXPIRED   | 07021150.3     | 1/26/99  | N/A                | 1901512   | 11/23/11 | 1/26/19  |
| 6936-28-PEP-3-HK       | Multicarrier Transmission System with Low Power Sleep Mode and Rapid-on-Capability | HK | ABANDONED | 08110349.9     | 1/26/99  | HK 1117978         |           |          | 7/28/11  |
| 6936-28-PEP-3-DIV-1    | Multicarrier Transmission System with Low Power Sleep Mode and Rapid-on-Capability | EP | EXPIRED   | 10011996.5     | 1/26/99  | 2302857            | 2302857   | 9/2/15   | 1/26/19  |
| 6936-28-PEP-3-DIV-1-DE | Multicarrier Transmission System with Low Power Sleep Mode and Rapid-on-Capability | DE | EXPIRED   | 10011996.5     | 1/26/99  |                    | 2302857   | 9/2/15   | 1/26/19  |
| 6936-28-PEP-3-DIV-1-FR | Multicarrier Transmission System with Low Power Sleep Mode and Rapid-on-Capability | FR | EXPIRED   | 10011996.5     | 1/26/99  |                    | 2302857   | 9/2/15   | 1/26/19  |
| 6936-28-PEP-3-DIV-1-GB | Multicarrier Transmission System with Low Power Sleep Mode and Rapid-on-Capability | GB | EXPIRED   | 10011996.5     | 1/26/99  |                    | 2302857   | 9/2/15   | 1/26/19  |
| 6936-28-PEP-3-DIV-2    | Multicarrier Transmission System with Low Power Sleep Mode and Rapid-on-Capability | EP | EXPIRED   | 10012013.8     | 1/26/99  | 2330749            | 2330749   | 4/30/14  | 1/26/19  |
| 6936-28-PEP-3-DIV-2-DE | Multicarrier Transmission System with Low Power Sleep Mode and Rapid-on-Capability | DE | EXPIRED   | 10012013.8     | 1/26/99  |                    | 2330749   | 4/30/14  | 1/26/19  |
| 6936-28-PEP-3-DIV-2-FR | Multicarrier Transmission System with Low Power Sleep Mode and Rapid-on-Capability | FR | EXPIRED   | 10012013.8     | 1/26/99  |                    | 2330749   | 4/30/14  | 1/26/19  |

|                        |                                                                                    |    |           |                 |          |                    |                |          |          |
|------------------------|------------------------------------------------------------------------------------|----|-----------|-----------------|----------|--------------------|----------------|----------|----------|
| 6936-28-PEP-3-DIV-2-GB | Multicarrier Transmission System with Low Power Sleep Mode and Rapid-on-Capability | GB | EXPIRED   | 10012013.8      | 1/26/99  |                    | 2330749        | 4/30/14  | 1/26/19  |
| 6936-28-PIP            | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY | JP | EXPIRED   | 2000-596705     | 1/26/99  | 2003-518341        | 4282907        | 3/27/09  | 1/26/19  |
| 6936-28-PIP-DIV        | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY | JP | ABANDONED | 2008-323651     | 1/26/99  | N/A                |                |          | 1/26/19  |
| 6936-28-PKR            | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY | KR | ABANDONED | 7009402/2001    | 1/26/99  | 10-2001-0108132    |                |          | 5/15/06  |
| 6936-28-PROV           | MULTICARRIER TRANSMISSION SYSTEM WITH LOW POWER SLEEP MODE AND RAPID-ON CAPABILITY | US | EXPIRED   | 60/072,447      | 1/26/98  | N/A                |                |          | 1/26/99  |
| 6936-55-PAU            | Initialization in the Presence of Impulse Noise                                    | AU | ISSUED    | 2005295758      | 10/14/05 | AU 2005295758      | 2005295758     | 7/9/10   | 10/14/25 |
| 6936-55-PAU-2          | Initialization in the Presence of Impulse Noise                                    | AU | ABANDONED | 2010202626      | 10/14/05 | AU 2010202626      |                |          | 6/27/11  |
| 6936-55-PCA            | DMT Symbol Repetition in the Presence of Impulse Noise                             | CA | ISSUED    | 2,582,106       | 10/14/05 | 2,582,106          | 2,582,106      | 4/28/15  | 10/14/25 |
| 6936-55-PCA-DIV        | DMT Symbol Repetition in the Presence of Impulse Noise                             | CA | ABANDONED | 2,881,036       | 10/14/05 | 2,881,036          |                | 12/22/15 | 9/8/20   |
| 6936-55-PCA-DIV-2      | DMT Symbol Repetition in the Presence of Impulse Noise                             | CA | ABANDONED | 2,906,478       | 10/14/05 |                    | 2,906,478      | 1/8/19   | 10/14/25 |
| 6936-55-PCN            | Initialization in the Presence of Impulse Noise                                    | CN | ISSUED    | 200580034464.3  | 10/14/05 | CN101040480A       | 200580034464.3 | 8/31/11  | 10/14/25 |
| 6936-55-PCV-HK         | DMT Symbol Repetition in the Presence of Impulse Noise                             | HK | ISSUED    | 08102934.7      | 10/14/05 | HK 1108783         | HK1108783      | 12/16/11 | 10/14/25 |
| 6936-55-PCT            | DMT Symbol Repetition in the Presence of Impulse Noise                             | WO | NAT PHASE | PCT/US05/36815  | 10/14/05 | WO 2006/044533 A1  |                |          |          |
| 6936-55-PEP            | DMT SYMBOL REPETITION IN THE PRESENCE OF IMPULSE NOISE                             | EP | ISSUED    | 05810124.7      | 10/14/05 | 1800427            | 1800427        | 6/20/12  | 10/14/25 |
| 6936-55-PEPBE          | Initialization in the Presence of Impulse Noise                                    | BE | ISSUED    | 05810124.7      | 10/14/05 |                    | 1800427        | 6/20/12  | 10/14/25 |
| 6936-55-PERCH          | Initialization in the Presence of Impulse Noise                                    | CH | ABANDONED | 05810124.7      | 10/14/05 |                    | 1800427        | 6/20/12  | 9/8/20   |
| 6936-55-PEPDE          | Initialization in the Presence of Impulse Noise                                    | DE | ISSUED    | 05810124.7      | 10/14/05 |                    | 1800427        | 6/20/12  | 10/14/25 |
| 6936-55-PEPDK          | Initialization in the Presence of Impulse Noise                                    | DK | ABANDONED | 05810124.7      | 10/14/05 |                    | 1800427        | 6/20/12  | 10/14/25 |
| 6936-55-PEPES          | Initialization in the Presence of Impulse Noise                                    | ES | ISSUED    | 05810124.7      | 10/14/05 |                    | 1800427        | 6/20/12  | 10/14/25 |
| 6936-55-PEPFR          | Initialization in the Presence of Impulse Noise                                    | FR | ISSUED    | 05810124.7      | 10/14/05 |                    | 1800427        | 6/20/12  | 10/14/25 |
| 6936-55-PEPGB          | Initialization in the Presence of Impulse Noise                                    | GB | ISSUED    | 05810124.7      | 10/14/05 |                    | 1800427        | 6/20/12  | 10/14/25 |
| 6936-55-PEPHK          | Initialization in the Presence of Impulse Noise                                    | HK | ISSUED    | 07112380.6      | 10/14/05 | HK 1103889         | 1103889        | 12/28/12 | 10/14/25 |
| 6936-55-PEPIT          | Initialization in the Presence of Impulse Noise                                    | IT | ISSUED    | 05810124.7      | 10/14/05 |                    | 1800427        | 6/20/12  | 10/14/25 |
| 6936-55-PEPNL          | Initialization in the Presence of Impulse Noise                                    | NL | ISSUED    | 05810124.7      | 10/14/05 |                    | 1800427        | 6/20/12  | 10/14/25 |
| 6936-55-PEPSE          | Initialization in the Presence of Impulse Noise                                    | SE | ABANDONED | 05810124.7      | 10/14/05 |                    | 1800427        | 6/20/12  | 10/14/25 |
| 6936-55-PEP-DIV        | Initialization in the Presence of Impulse Noise                                    | EP | ISSUED    | 11000980.0      | 10/14/05 | 2312784            | 2312784        | 2/1/17   | 10/14/25 |
| 6936-55-PEP-DIV-DE     | Initialization in the Presence of Impulse Noise                                    | DE | ISSUED    | 11000980.0      | 10/14/05 |                    | 2312784        | 2/1/17   | 10/14/25 |
| 6936-55-PEP-DIV-FR     | Initialization in the Presence of Impulse Noise                                    | FR | ISSUED    | 11000980.0      | 10/14/05 |                    | 2312784        | 2/1/17   | 10/14/25 |
| 6936-55-PEP-DIV-GB     | Initialization in the Presence of Impulse Noise                                    | GB | ISSUED    | 11000980.0      | 10/14/05 |                    | 2312784        | 2/1/17   | 10/14/25 |
| 6936-55-PEP-DIV-2      | Initialization in the Presence of Impulse Noise                                    | EP | PUBLISHED | 17020039.8      | 10/14/05 | 3220567            |                |          | 10/14/25 |
| 6936-55-PEP-DIV-2-HK   | Initialization in the Presence of Impulse Noise                                    | HK | PUBLISHED | 18100419.3      | 10/14/15 | 1241167            |                |          | 10/14/35 |
| 6936-55-PIN            | Initialization in the Presence of Impulse Noise                                    | IN | ABANDONED | 1209/KOLNP/2007 | 10/14/05 | IN 1209/KOLNP/2007 |                |          | 10/15/24 |
| 6936-55-PIP            | DMT Symbol Repetition in the Presence of Impulse Noise                             | JP | ABANDONED | 2007-536883     | 10/14/05 | 2008-517535        |                |          | 4/15/13  |
| 6936-55-PIP-DIV        | DMT Symbol Repetition in the Presence of Impulse Noise                             | JP | ABANDONED | 2008-264567     | 10/14/05 | 2009-081862        |                |          | 4/15/13  |
| 6936-55-PKR            | DMT SYMBOL REPETITION IN THE PRESENCE OF IMPULSE NOISE                             | KR | ISSUED    | 10-2007-7008275 | 10/14/05 | 10-2007-0061867    | 10-1272404     | 5/31/13  | 10/14/25 |
| 6936-55-PKR-DIV        | DMT Symbol Repetition in the Presence of Impulse Noise                             | KR | ISSUED    | 10-2010-7022479 | 10/14/05 | 10-2010/03121542   | 10-1314976     | 9/27/13  | 10/14/25 |
| 6936-55-PKR-DIV-2      | DMT Symbol Repetition in the Presence of Impulse Noise                             | KR | ABANDONED | 10-2012-7021605 | 10/14/05 |                    |                |          | 4/16/13  |
| 6936-55-PROV           | XDSL INITIALIZATION IN THE PRESENCE OF IMPULSE NOISE                               | US | EXPIRED   | 60/619,618      | 10/15/04 | N/A                |                |          | 10/15/05 |
| 6936-55-PUS            | DMT Symbol Repetition in the Presence of Impulse Noise                             | US | ISSUED    | 11/575,598      | 3/20/07  | US 2007-0217491 A1 | 7,796,705      | 9/14/10  | 8/22/27  |
| 6936-55-PUS-CON        | Impulse Noise Protection During Initialization                                     | US | ISSUED    | 12/769,747      | 4/29/10  | US 2010-0208842 A1 | 8,913,649      | 12/16/14 | 10/14/25 |
| 6936-55-PUS-CON-2      | DMT Symbol Repetition in the Presence of Impulse Noise                             | US | ISSUED    | 14/559,156      | 12/3/14  | US 2015-0146821 A1 | 9,621,198      | 4/11/17  | 10/14/25 |
| 6936-55-PUS-CON-3      | DMT SYMBOL REPETITION IN THE PRESENCE OF IMPULSE NOISE                             | US | ABANDONED | 15/479,866      | 4/5/17   | US 2017-0214487 A1 |                |          | 9/12/19  |
| 6936-55-PUS-CON-4      | DMT SYMBOL REPETITION IN THE PRESENCE OF IMPULSE NOISE                             | US | PUBLISHED | 16/569,144      | 9/12/19  | US 2020-0007268 A1 |                |          | 10/14/25 |
| 6936-57-PAU            | Packet Retransmission and Memory Sharing                                           | AU | ABANDONED | 2007257055      | 4/12/07  | AU 2007257055      |                |          | 4/12/27  |
| 6936-57-PBR            | Packet Retransmission and Memory Sharing                                           | BR | ISSUED    | PI-0709871-5    | 4/12/07  | BR P10/09871       | PI 0709871-5   | 10/15/19 | 10/15/29 |
| 6936-57-PCA            | Packet Retransmission and Memory Sharing                                           | CA | ISSUED    | 2,647,589       | 4/12/07  | CA 2647589         | 2,647,589      | 8/21/18  | 4/12/27  |

|                       |                                          |    |           |                  |          |                    |            |                   |
|-----------------------|------------------------------------------|----|-----------|------------------|----------|--------------------|------------|-------------------|
| 6936-57-PCA-DIV       | Packet Retransmission and Memory Sharing | CA | PENDING   | 3/11/163         | 4/12/07  |                    |            | 4/12/27           |
| 6936-57-PCN           | Packet Retransmission and Memory Sharing | CN | ABANDONED | 200780012891.0   | 4/12/07  | CNI01421992A       |            | 4/16/13           |
| 6936-57-PCN-HK        | Packet Retransmission and Memory Sharing | HK | ABANDONED | 09109954.6       | 4/12/07  | HK 1133132         |            | 4/16/13           |
| 6936-57-PCD           | Packet Retransmission and Memory Sharing | CO | ABANDONED | 08-109.377       | 4/12/07  | 08-109.377         |            | 4/12/27           |
| 6936-57-PCI           | Packet Retransmission and Memory Sharing | WO | NAT PHASE | PCT/US07/66522   | 4/12/07  | WO 2007/143277     |            |                   |
| 6936-57-PEP           | Packet Retransmission and Memory Sharing | EP | ISSUED    | 07811844.5       | 4/12/07  | 2005674            | 2005674    | 9/28/16 4/12/27   |
| 6936-57-PEP-DE        | Packet Retransmission and Memory Sharing | DE | ISSUED    | 07811844.5       | 4/12/07  |                    | 2005674    | 9/28/16 4/12/27   |
| 6936-57-PEP-FR        | Packet Retransmission and Memory Sharing | FR | ISSUED    | 07811844.5       | 4/12/07  |                    | 2005674    | 9/28/16 4/12/27   |
| 6936-57-PEP-GB        | Packet Retransmission and Memory Sharing | GB | ISSUED    | 07811844.5       | 4/12/07  |                    | 2005674    | 9/28/16 4/12/27   |
| 6936-57-PEP-DIV       | Packet Retransmission and Memory Sharing | EP | ISSUED    | 1000001.7.3      | 4/12/07  | 2178254            | 2178254    | 2/8/17 4/12/27    |
| 6936-57-PEP-DIV-DE    | Packet Retransmission and Memory Sharing | DE | ISSUED    | 1000001.7.3      | 4/12/07  |                    | 2178254    | 2/8/17 4/12/27    |
| 6936-57-PEP-DIV-FR    | Packet Retransmission and Memory Sharing | FR | ISSUED    | 1000001.7.3      | 4/12/07  |                    | 2178254    | 2/8/17 4/12/27    |
| 6936-57-PEP-DIV-GB    | Packet Retransmission and Memory Sharing | GB | ISSUED    | 1000001.7.3      | 4/12/07  |                    | 2178254    | 2/8/17 4/12/27    |
| 6936-57-PEP-DIV-HK    | Packet Retransmission and Memory Sharing | HK | ABANDONED | 10104429.1       | 4/12/07  | HK 1136723         |            | 10/26/16          |
| 6936-57-PEP-DIV-2     | Packet Retransmission and Memory Sharing | EP | ISSUED    | 10000016.5       | 4/12/07  | 2173071            | 2173071    | 6/26/13 4/12/27   |
| 6936-57-PEP-DIV-2-BE  | Packet Retransmission and Memory Sharing | BE | ABANDONED | 10000016.5       | 4/12/07  |                    | 2173071    | 6/26/13 1/13/17   |
| 6936-57-PEP-DIV-2-DE  | Packet Retransmission and Memory Sharing | DE | ABANDONED | 10000016.5       | 4/12/07  |                    | 2173071    | 6/26/13 1/13/17   |
| 6936-57-PEP-DIV-2-FR  | Packet Retransmission and Memory Sharing | FR | ABANDONED | 10000016.5       | 4/12/07  |                    | 2173071    | 6/26/13 1/13/17   |
| 6936-57-PEP-DIV-2-GB  | Packet Retransmission and Memory Sharing | GB | ABANDONED | 10000016.5       | 4/12/07  |                    | 2173071    | 6/26/13 1/13/17   |
| 6936-57-PEP-DIV-2-HK  | Packet Retransmission and Memory Sharing | HK | ABANDONED | 10103698.7       | 4/12/07  | HK 1135537         | 1135537    | 11/15/13 1/13/17  |
| 6936-57-PEP-DIV-3     | Packet Retransmission and Memory Sharing | EP | ISSUED    | 17020026.5       | 4/12/07  | 3190756            | 3190756    | 10/31/18 4/12/27  |
| 6936-57-PEP-DIV-3-DE  | Packet Retransmission and Memory Sharing | DE | ISSUED    | 17020026.5       | 4/12/07  |                    | 3190756    | 10/31/18 4/12/27  |
| 6936-57-PEP-DIV-3-FR  | Packet Retransmission and Memory Sharing | FR | ISSUED    | 17020026.5       | 4/12/07  |                    | 3190756    | 10/31/18 4/12/27  |
| 6936-57-PEP-DIV-3-GB  | Packet Retransmission and Memory Sharing | GB | ISSUED    | 17020026.5       | 4/12/07  |                    | 3190756    | 10/31/18 4/12/27  |
| 6936-57-PEP-DIV-4     | Packet Retransmission and Memory Sharing | EP | PUBLISHED | 17020525.6       | 4/12/07  | 3301871            |            | 4/12/27           |
| 6936-57-PEP-DIV-4-HK  | Packet Retransmission and Memory Sharing | HK | PENDING   | 18110134.6       | 4/12/07  |                    |            | 4/12/27           |
| 6936-57-PIN           | Packet Retransmission and Memory Sharing | IN | ABANDONED | 4084/KOLNP/2008  | 4/12/07  | IN 4084/KOLNP/2008 |            | 4/12/27           |
| 6936-57-PJP           | 6936and Memory Sharing                   | JP | ABANDONED | 2009-503623      | 4/12/07  | 2009-533973        |            | 2/27/12           |
| 6936-57-PJP-DIV       | Packet Retransmission and Memory Sharing | JP | ABANDONED | 2010-017356      | 4/12/07  | 2010-136427        |            | 10/2/12           |
| 6936-57-PJP-DIV-2     | Packet Retransmission and Memory Sharing | JP | ISSUED    | 2012-042978      | 4/12/07  | 2012-151863        | 5486621    | 2/28/14 4/12/27   |
| 6936-57-PJP-DIV-3     | Packet Retransmission and Memory Sharing | JP | ISSUED    | 2013-246257      | 4/12/07  | 2014-090433        | 5948307    | 6/10/16 4/12/27   |
| 6936-57-PKR           | Packet Retransmission and Memory Sharing | KR | ISSUED    | 10-2008-7024792  | 4/12/07  | 10-2008-0108127    | 10-1736999 | 5/11/17 4/12/27   |
| 6936-57-PKR-DIV       | Packet Retransmission and Memory Sharing | KR | ABANDONED | 10-2014-7005299  | 4/12/07  |                    |            | 6/20/16           |
| 6936-57-PKR-DIV-2     | Packet Retransmission and Memory Sharing | KR | ABANDONED | 10-2017-7012757  | 4/12/07  |                    |            | 1/12/18           |
| 6936-57-PKR-DIV-3     | Packet Retransmission and Memory Sharing | KR | ISSUED    | 10-2017-7036067  | 4/12/07  |                    | 10-1952812 | 2/21/19 4/12/27   |
| 6936-57-PKR-DIV-4     | Packet Retransmission and Memory Sharing | KR | ISSUED    | 10-2019-7005116  | 4/12/07  |                    | 10-2151398 | 8/28/20 4/12/27   |
| 6936-57-PMX           | Packet Retransmission and Memory Sharing | MX | ISSUED    | MX/a/2008/012505 | 4/12/07  | MX 2008012505      | 301471     | 7/18/12 4/12/27   |
| 6936-57-PMX-DIV       | Packet Retransmission and Memory Sharing | MX | ABANDONED | MX/a/2011/005751 | 4/12/07  |                    |            | 4/12/27           |
| 6936-57-PROV          | XDSL PACKET RETRANSMISSION MECHANISM     | US | EXPIRED   | 60/792.236       | 4/12/06  | N/A                |            | 4/12/07           |
| 6936-57-PUS           | Packet Retransmission and Memory Sharing | US | ISSUED    | 12/295.828       | 10/2/08  | US 2009-0300450 A1 | 8,335,956  | 12/18/12 10/11/25 |
| 6936-57-PUS-CON       | Packet Retransmission and Memory Sharing | US | ISSUED    | 12/783.758       | 5/20/10  | US 2011-0002331 A1 | 8,407,546  | 3/26/13 7/23/28   |
| 6936-57-PUS-CON-2     | Packet Retransmission and Memory Sharing | US | ISSUED    | 13/766.059       | 2/13/13  | US 2013-0163592 A1 | 8,645,784  | 2/4/14 4/12/27    |
| 6936-57-PUS-CON-3     | Packet Retransmission and Memory Sharing | US | ISSUED    | 14/159.125       | 1/20/14  | US 2014-0133491 A1 | 9,485,055  | 11/1/16 4/12/27   |
| 6936-57-PUS-CON-4     | PACKET RETRANSMISSION AND MEMORY SHARING | US | ISSUED    | 15/298.526       | 10/20/16 | US 2017-0041224 A1 | 10,044,473 | 8/7/18 4/12/27    |
| 6936-57-PUS-CON-5     | PACKET RETRANSMISSION AND MEMORY SHARING | US | ISSUED    | 16/046.494       | 7/26/18  | US 2018-0331790 A1 | 10,484,140 | 11/19/19 10/11/25 |
| 6936-57-PUS-CON-6     | PACKET RETRANSMISSION AND MEMORY SHARING | US | PUBLISHED | 16/561.835       | 9/5/19   | US 2019-0393991 A1 |            | 4/12/27           |
| 6936-57-PUS-DIV       | Packet Retransmission                    | US | ISSUED    | 12/760.728       | 4/15/10  | US 2010-0205501 A1 | 8,595,577  | 11/26/13 8/28/27  |
| 6936-57-PUS-DIV-CON   | Packet Retransmission                    | US | ISSUED    | 12/783.765       | 5/20/10  | US 2010-0332935 A1 | 8,468,411  | 6/18/13 10/11/25  |
| 6936-57-PUS-DIV-CON-2 | Packet Retransmission                    | US | ISSUED    | 14/075.194       | 11/8/13  | US 2014-0068366 A1 | 9,094,348  | 7/28/15 4/12/27   |
| 6936-57-PUS-DIV-CON-3 | Packet Retransmission                    | US | ISSUED    | 14/742.334       | 6/17/15  | US 2015-0312001 A1 | 9,749,235  | 8/29/17 4/12/27   |

|                       |                                                                                             |    |           |                |          |                    |            |          |          |
|-----------------------|---------------------------------------------------------------------------------------------|----|-----------|----------------|----------|--------------------|------------|----------|----------|
| 6936-57-PUS-DIV-CDN-4 | Packet Retransmission                                                                       | US | ISSUED    | 15/678,870     | 8/16/17  | US 2017-0373971 A1 | 10,498,495 | 12/3/19  | 4/12/27  |
| 6936-57-PUS-DIV-CDN-5 | TECHNIQUES FOR PACKET AND MESSAGE COMMUNICATION IN A MULTICARRIER TRANSCIVER ENVIRONMENT    | US | ISSUED    | 16/701,343     | 12/3/19  | US 2020-0106558 A1 | 10,833,809 | 11/10/20 | 4/12/27  |
| 6936-57-PUS-DIV-CDN-6 | PACKET RETRANSMISSION                                                                       | US | PENDING   | 17/027,196     | 9/21/20  |                    |            |          | 4/12/27  |
| 6936-59-PROV          | XDSP Packet Retransmission Mechanism With Examples                                          | US | EXPIRE D  | 60/849,650     | 10/5/06  | N/A                |            |          | 10/5/07  |
| 6936-26               | SYSTEMS AND METHODS FOR A MULTICARRIER MODULATION SYSTEM WITH A VARIABLE MARGIN             | US | ABANDONED | 09/836,295     | 4/18/01  | US 2002-0009135    |            |          | 10/4/05  |
| 6936-26-CDN           | SYSTEMS AND METHODS FOR A MULTICARRIER MODULATION SYSTEM WITH A VARIABLE MARGIN             | US | ABANDONED | 11/242,024     | 10/4/05  | US 2006-0018395 A1 |            |          | 4/18/21  |
| 6936-26-CDN-2         | Systems and Methods for a Multicarrier Modulation System with a Variable Margin             | US | ABANDONED | 11/972,340     | 1/10/08  | US 2008-0107204 A1 |            |          | 7/27/11  |
| 6936-26-CDN-3         | Systems and Methods for a Multicarrier Modulation System with a Variable Margin             | US | ISSUED    | 12/694,143     | 1/26/10  | US 2010-0128810 A1 | 8,374,226  | 2/12/13  | 7/3/21   |
| 6936-26-CDN-4         | Systems and Methods for a Multicarrier Modulation System with a Variable Margin             | US | ABANDONED | 13/467,392     | 5/9/12   | US 2012-0219047 A1 |            |          | 4/18/21  |
| 6936-26-CDN-5         | Systems and Methods for a Multicarrier Modulation System with a Variable Margin             | US | ISSUED    | 13/764,529     | 2/11/13  | US 2013-0148708 A1 | 8,625,660  | 1/7/14   | 4/18/21  |
| 6936-26-CDN-6         | Systems and Methods for a Multicarrier Modulation System with a Variable Margin             | US | ISSUED    | 14/079,285     | 11/13/13 | US 2014-0072062 A1 | 8,937,988  | 1/20/15  | 4/18/21  |
| 6936-26-CDN-7         | Systems and Methods for a Multicarrier Modulation System with a Variable Margin             | US | ISSUED    | 14/591,612     | 1/7/15   | US 2015-0117557 A1 | 9,154,354  | 10/6/15  | 4/18/21  |
| 6936-26-CDN-8         | SYSTEMS AND METHODS FOR A MULTICARRIER MODULATION SYSTEM WITH A VARIABLE MARGIN             | US | ABANDONED | 14/965,966     | 9/25/15  | US 2016-0013962 A1 |            |          | 12/13/16 |
| 6936-26-CDN-9         | SYSTEMS AND METHODS FOR A MULTICARRIER MODULATION SYSTEM WITH A VARIABLE MARGIN             | US | ISSUED    | 15/348,372     | 11/10/16 | US 2017-0078128 A1 | 9,893,921  | 2/13/18  | 4/18/21  |
| 6936-26-CDN-10        | SYSTEMS AND METHODS FOR A MULTICARRIER MODULATION SYSTEM WITH A VARIABLE MARGIN             | US | ISSUED    | 15/886,295     | 2/1/18   | US 2018-0159711 A1 | 10,708,104 | 7/7/20   | 4/18/21  |
| 6936-26-PAU           | MULTICARRIER MODULATION SYSTEM WITH VARIABLE MARGIN TO ACCOUNT FOR TIME VARYING IMPAIRMENTS | AU | ABANDONED | 2001257081     | 4/18/01  | N/A                |            |          |          |
| 6936-26-PAU-CON       | Data Allocation with Variable SNR Margins                                                   | AU | ISSUED    | 2007200448     | 4/18/01  | AU 2007200448      | 2007200448 | 8/6/09   | 4/18/21  |
| 6936-26-PAU-CON-2     | Data Allocation with Variable SNR Margins                                                   | AU | ABANDONED | 2009202880     | 4/18/05  | AU 2009202880      |            |          | 10/18/11 |
| 6936-26-PCA           | MULTICARRIER MODULATION SYSTEM WITH VARIABLE MARGIN TO ACCOUNT FOR TIME VARYING IMPAIRMENTS | CA | ISSUED    | 2,406,151      | 4/18/01  | CA 2405151         | 2,406,151  | 4/13/10  | 4/18/21  |
| 6936-26-PCA-2         | DATA ALLOCATION WITH VARIABLE SNR MARGINS                                                   | CA | ABANDONED | 2,689,952      | 4/18/01  | CA 689952          |            |          | 2/24/11  |
| 6936-26-PCT           | MULTICARRIER MODULATION SYSTEM WITH VARIABLE MARGIN TO ACCOUNT FOR TIME VARYING IMPAIRMENTS | WO | NAT PHASE | PCT/US01/12555 | 4/18/01  | WO 2001/080510     |            |          |          |
| 6936-26-PEP           | MULTICARRIER MODULATION SYSTEM WITH VARIABLE MARGIN TO ACCOUNT FOR TIME VARYING IMPAIRMENTS | EP | ABANDONED | 01930554.9     | 4/18/01  | EP 1275229         | 1275229    | 3/21/07  | 4/18/21  |
| 6936-26-PEPBE         | Data Allocation With Variable SNR Margins                                                   | BE | ABANDONED | 01930554.9     | 4/18/01  | N/A                | 1275229    | 3/21/07  | 4/18/21  |
| 6936-26-PEPDE         | Data Allocation With Variable SNR Margins                                                   | DE | ABANDONED | 01930554.9     | 4/18/01  | N/A                | 1275229    | 3/21/07  | 4/18/21  |
| 6936-26-PEPFR         | Data Allocation With Variable SNR Margins                                                   | FR | ABANDONED | 01930554.9     | 4/18/01  | N/A                | 1275229    | 3/21/07  | 4/18/21  |
| 6936-26-PEPGB         | Data Allocation With Variable SNR Margins                                                   | GB | ABANDONED | 01930554.9     | 4/18/01  | N/A                | 1275229    | 3/21/07  | 4/18/21  |
| 6936-26-PEP-DIV       | Data Allocation With Variable SNR Margins                                                   | EP | ISSUED    | 07005676.7     | 4/18/01  | 1830535            | 1830535    | 6/15/11  | 4/18/21  |
| 6936-26-PEP-DIV-BE    | Data Allocation With Variable SNR Margins                                                   | BE | ISSUED    | 07005676.7     | 4/18/01  | N/A                | 1830535    | 9/5/07   | 4/18/21  |
| 6936-26-PEP-DIV-DE    | Data Allocation With Variable SNR Margins                                                   | DE | ISSUED    | 07005676.7     | 4/18/01  |                    | 1830535    | 6/15/11  | 4/18/21  |
| 6936-26-PEP-DIV-FR    | Data Allocation With Variable SNR Margins                                                   | FR | ISSUED    | 07005676.7     | 4/18/01  | N/A                | 1830535    | 9/5/07   | 4/18/21  |
| 6936-26-PEP-DIV-GB    | Data Allocation With Variable SNR Margins                                                   | GB | ISSUED    | 07005676.7     | 4/18/01  | N/A                | 1830535    | 9/5/07   | 4/18/21  |
| 6936-26-PEP-DIV-2     | MULTICARRIER MODULATION SYSTEM WITH VARIABLE MARGIN TO ACCOUNT FOR TIME VARYING IMPAIRMENTS | EP | ABANDONED | 10011998.1     | 4/18/01  | 2267963            |            |          | 4/18/21  |
| 6936-26-PJP           | MULTICARRIER MODULATION SYSTEM WITH VARIABLE MARGIN TO ACCOUNT FOR TIME VARYING IMPAIRMENTS | JP | ABANDONED | 2001-576639    | 4/18/01  | 2004-501535        |            |          | 4/18/21  |
| 6936-26-PKR           | MULTICARRIER MODULATION SYSTEM WITH VARIABLE MARGIN TO ACCOUNT FOR TIME VARYING IMPAIRMENTS | KR | ABANDONED | 2002-7013983   | 4/18/01  | 10-2002-087990     |            |          | 4/18/21  |
| 6936-26-PROV          | MULTICARRIER MODULATION SYSTEM WITH VARIABLE MARGIN TO ACCOUNT FOR TIME VARYING IMPAIRMENTS | US | EXPIRE D  | 60/197,727     | 4/18/00  | N/A                |            |          | 4/18/01  |

|                       |                                                        |    |           |                |         |                 |                 |          |         |
|-----------------------|--------------------------------------------------------|----|-----------|----------------|---------|-----------------|-----------------|----------|---------|
| 6936-7-CON            | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | US | ABANDONED | 10/202,688     | 7/25/02 | US 2003-0007509 |                 |          | 7/13/06 |
| 6936-7-PAU            | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | AU | EXPIRED   | 48339/99       | 6/25/99 | AU 4833999      | 750898          | 11/21/02 | 6/25/19 |
| 6936-7-PAU-2          | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | AU | EXPIRED   | 2002301627     | 6/25/99 | AU 2002301627   | 2002301627      | 8/6/04   | 6/25/19 |
| 6936-7-PAU-3          | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | AU | ABANDONED | 2004203322     | 6/25/99 | AU 2004203322   | 2004203322      | 10/11/07 | 5/4/17  |
| 6936-7-PAU-4          | Multicarrier Communication With Variable Overhead Rate | AU | ABANDONED | 2007202930     | 6/25/99 | AU 2007202930   |                 |          | 6/25/19 |
| 6936-7-PAU-4-DIV      | Multicarrier Communication With Variable Overhead Rate | AU | ABANDONED | 2010249199     | 6/25/99 | AU 2010249199   |                 |          | 6/25/19 |
| 6936-7-PCA            | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | CA | ABANDONED | 2,335,865      | 6/25/99 | CA 2333865      | 2,335,865       | 12/16/08 | 3/10/17 |
| 6936-7-PCA-DIV        | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | CA | EXPIRED   | 2,641,978      | 6/25/99 | CA 2641978      | 2,641,978       | 1/6/15   | 6/25/19 |
| 6936-7-PCA-DIV-2      | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | CA | EXPIRED   | 2,867,539      | 6/25/99 |                 | 2,867,539       | 3/14/17  | 6/25/19 |
| 6936-7-PCT            | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | WO | NAT PHASE | PCT/US99/14467 | 6/25/99 | WO 2000/001127  |                 |          |         |
| 6936-7-PEP-2          | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | EP | EXPIRED   | 04012683.1     | 6/25/99 | 1453268         | 1453268         | 3/8/06   | 6/25/19 |
| 6936-7-PEPAT-2        | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | AT | EXPIRED   | 04012683.1     | 6/25/99 | N/A             | 1453268         | 3/8/06   | 6/25/19 |
| 6936-7-PEPBE-2        | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | BE | EXPIRED   | 04012683.1     | 6/25/99 | N/A             | 1453268         | 3/8/06   | 6/25/19 |
| 6936-7-PEPCH-2        | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | CH | EXPIRED   | 04012683.1     | 6/25/99 | N/A             | 1453268         | 3/8/06   | 6/25/19 |
| 6936-7-PEPDE-2        | Multicarrier Communication With Variable Overhead Rate | DE | EXPIRED   | 04012683.1     | 6/25/99 | N/A             | 1453268         | 3/8/06   | 6/25/19 |
| 6936-7-PEPES-2        | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | ES | EXPIRED   | 04012683.1     | 6/25/99 | N/A             | 1453268         | 3/8/06   | 6/25/19 |
| 6936-7-PEPFI-2        | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | FI | EXPIRED   | 04012683.1     | 6/25/99 | N/A             | 1453268         | 3/8/06   | 6/25/19 |
| 6936-7-PEPFR-2        | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | FR | EXPIRED   | 04012683.1     | 6/25/99 | N/A             | 1453268         | 3/8/06   | 6/25/19 |
| 6936-7-PEPGB-2        | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | GB | EXPIRED   | 04012683.1     | 6/25/99 | N/A             | 1453268         | 3/8/06   | 6/25/19 |
| 6936-7-PEPGR-2        | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | GR | EXPIRED   | 04012683.1     | 6/25/99 | N/A             | 1453268         | 3/8/06   | 6/25/19 |
| 6936-7-PEPHK-2        | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | HK | EXPIRED   | 05101665.7     | 6/25/99 | HK 1068080      | HK1068080       | 5/6/06   | 6/25/19 |
| 6936-7-PEPIE-2        | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | IE | EXPIRED   | 04012683.1     | 6/25/99 | N/A             | 1453268         | 3/8/06   | 6/25/19 |
| 6936-7-PEPIT-2        | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | IT | EXPIRED   | 04012683.1     | 6/25/99 | N/A             | 1453268         | 3/8/06   | 6/25/19 |
| 6936-7-PEPNL-2        | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | NL | EXPIRED   | 04012683.1     | 6/25/99 | N/A             | 1453268         | 3/8/06   | 6/25/19 |
| 6936-7-PEPS-2         | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | SE | EXPIRED   | 04012683.1     | 6/25/99 | N/A             | 1453268         | 3/8/06   | 6/25/19 |
| 6936-7-PEP-3          | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | EP | EXPIRED   | 06004566.3     | 6/25/99 | EP 1667392      | 1667392         | 1/10/18  | 6/25/19 |
| 6936-7-PEP-3-DE       | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | DE | EXPIRED   | 06004566.3     | 6/25/99 |                 | 1667392         | 1/10/18  | 6/25/19 |
| 6936-7-PEP-3-FR       | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | FR | EXPIRED   | 06004566.3     | 6/25/99 |                 | 1667392         | 1/10/18  | 6/25/19 |
| 6936-7-PEP-3-GB       | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | GB | EXPIRED   | 06004566.3     | 6/25/99 |                 | 1667392         | 1/10/18  | 6/25/19 |
| 6936-7-PEP-3-HK       | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | HK | EXPIRED   | 06112790.1     | 6/25/99 | 1091070         | HK1091070       | 6/22/18  | 6/25/19 |
| 6936-7-PEP-3-DIV-1    | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | EP | EXPIRED   | 10011974.2     | 6/25/99 | 2278765         | 2278765         | 11/7/18  | 6/25/19 |
| 6936-7-PEP-3-DIV-1-AT | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | AT | EXPIRED   | 10011974.2     | 6/25/99 |                 | 2278765         | 11/7/18  | 6/25/19 |
| 6936-7-PEP-3-DIV-1-BE | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | BE | EXPIRED   | 10011974.2     | 6/25/99 |                 | 2278765         | 11/7/18  | 6/25/19 |
| 6936-7-PEP-3-DIV-1-CH | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | CH | EXPIRED   | 10011974.2     | 6/25/99 |                 | 2278765         | 11/7/18  | 6/25/19 |
| 6936-7-PEP-3-DIV-1-DE | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | DE | EXPIRED   | 10011974.2     | 6/25/99 | 2278765         | DE 699 45 900.1 | 11/7/18  | 6/25/19 |
| 6936-7-PEP-3-DIV-1-ES | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | ES | EXPIRED   | 10011974.2     | 6/25/99 |                 | 2278765         | 11/7/18  | 6/25/19 |
| 6936-7-PEP-3-DIV-1-FI | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | FI | EXPIRED   | 10011974.2     | 6/25/99 |                 | 2278765         | 11/7/18  | 6/25/19 |
| 6936-7-PEP-3-DIV-1-FR | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | FR | EXPIRED   | 10011974.2     | 6/25/99 |                 | 2278765         | 11/7/18  | 6/25/19 |
| 6936-7-PEP-3-DIV-1-GB | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | GB | EXPIRED   | 10011974.2     | 6/25/99 |                 | 2278765         | 11/7/18  | 6/25/19 |
| 6936-7-PEP-3-DIV-1-GR | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | GR | EXPIRED   | 10011974.2     | 6/25/99 |                 | 2278765         | 11/7/18  | 6/25/19 |
| 6936-7-PEP-3-DIV-1-IE | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | IE | EXPIRED   | 10011974.2     | 6/25/99 |                 | 2278765         | 11/7/18  | 6/25/19 |
| 6936-7-PEP-3-DIV-1-IT | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | IT | EXPIRED   | 10011974.2     | 6/25/99 |                 | 2278765         | 11/7/18  | 6/25/19 |
| 6936-7-PEP-3-DIV-1-NL | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | NL | EXPIRED   | 10011974.2     | 6/25/99 |                 | 2278765         | 11/7/18  | 6/25/19 |
| 6936-7-PEP-3-DIV-1-SE | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | SE | EXPIRED   | 10011974.2     | 6/25/99 |                 | 2278765         | 11/7/18  | 6/25/19 |
| 6936-7-PEP-3-DIV-2    | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | EP | EXPIRED   | 10011980.9     | 6/25/99 | 2278766         | 2278766         | 11/7/18  | 6/25/19 |
| 6936-7-PEP-3-DIV-2-DE | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | DE | EXPIRED   | 10011980.9     | 6/25/99 | 2278766         | DE 699 45 902.8 | 11/7/18  | 6/25/19 |
| 6936-7-PEP-3-DIV-2-FR | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | FR | EXPIRED   | 10011980.9     | 6/25/99 |                 | 2278766         | 11/7/18  | 6/25/19 |
| 6936-7-PEP-3-DIV-2-GB | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE | GB | EXPIRED   | 10011980.9     | 6/25/99 |                 | 2278766         | 11/7/18  | 6/25/19 |

|                       |                                                                                                                    |    |           |                 |         |                    |                 |          |          |
|-----------------------|--------------------------------------------------------------------------------------------------------------------|----|-----------|-----------------|---------|--------------------|-----------------|----------|----------|
| 6936-7-PEP-3-DIV-3    | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE                                                             | EP | EXPIRED   | 10011981.7      | 6/25/99 | 2278767            | 2278767         | 11/7/18  | 6/25/19  |
| 6936-7-PEP-3-DIV-3-DE | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE                                                             | DE | EXPIRED   | 10011981.7      | 6/25/99 | 2278767            | DE 699 45 903.6 | 11/7/18  | 6/25/19  |
| 6936-7-PEP-3-DIV-3-FR | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE                                                             | FR | EXPIRED   | 10011981.7      | 6/25/99 |                    | 2278767         | 11/7/18  | 6/25/19  |
| 6936-7-PEP-3-DIV-3-GB | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE                                                             | GB | EXPIRED   | 10011981.7      | 6/25/99 |                    | 2278767         | 11/7/18  | 6/25/19  |
| 6936-7-PKR            | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE                                                             | KR | ABANDONED | 2000-7014830    | 6/25/99 | 10-2001-0053220    | 10-0955169      | 4/20/10  | 3/10/17  |
| 6936-7-PKR-2          | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE                                                             | KR | EXPIRED   | 10-2010-7002843 | 6/25/99 | 10-2010-0031635    | 10-1006609      | 12/30/10 | 6/25/19  |
| 6936-7-PKR-3          | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE                                                             | KR | ABANDONED | 10-2010-7021589 | 6/25/99 | 10-2010-0121683    |                 |          | 6/25/19  |
| 6936-7-PROV           | MULTICARRIER COMMUNICATION WITH VARIABLE OVERHEAD RATE                                                             | US | EXPIRED   | 60/090,891      | 6/26/98 | N/A                |                 |          | 6/26/99  |
| 6936-3                | SYSTEM AND METHOD FOR THE APPLICATION OF AN LMS METHOD TO UPDATING AN ECHO CANCELLER IN AN ADSL MODEM              | US | ABANDONED | 09/768,275      | 1/25/01 | US 2001-0040875    |                 |          | 8/25/05  |
| 6936-3-CON            | SYSTEM AND METHOD FOR THE APPLICATION OF AN LMS METHOD TO UPDATING AN ECHO CANCELLER IN AN ADSL MODEM              | US | ABANDONED | 11/058,289      | 2/16/05 | US 2005-0141441 A1 |                 |          | 5/9/06   |
| 6936-3-CON-2          | SYSTEM AND METHOD FOR THE APPLICATION OF AN LMS METHOD TO UPDATING AN ECHO CANCELLER IN AN ADSL MODEM              | US | ABANDONED | 11/430,251      | 5/9/06  | US 2006-0215587 A1 |                 |          | 12/10/10 |
| 6936-3-CON-3          | SYSTEM AND METHOD FOR THE APPLICATION OF AN LMS METHOD TO UPDATING AN ECHO CANCELLER IN AN ADSL MODEM              | US | ISSUED    | 12/783,740      | 5/20/10 | US 2010-0296663 A1 | 8,391,191       | 3/3/13   | 1/29/21  |
| 6936-3-CON-4          | SYSTEM AND METHOD FOR THE APPLICATION OF AN LMS METHOD TO UPDATING AN ECHO CANCELLER IN AN ADSL MODEM              | US | ABANDONED | 12/783,744      | 5/20/10 | N/A                |                 |          | 2/18/11  |
| 6936-3-CON-5          | SYSTEM AND METHOD FOR THE APPLICATION OF AN LMS METHOD TO UPDATING AN ECHO CANCELLER IN AN ADSL MODEM              | US | ISSUED    | 13/772,516      | 2/21/13 | US 2013-0163749 A1 | 8,649,305       | 2/11/14  | 1/25/21  |
| 6936-3-CON-6          | System and Method for the Application of an LMS Method to Updating an Echo Canceller in an ADSL Modem              | US | ISSUED    | 14/164,632      | 1/27/14 | US 2014-0140499 A1 | 9,065,886       | 6/23/15  | 1/25/21  |
| 6936-3-CON-7          | SYSTEM AND METHOD FOR THE APPLICATION OF AN LMS METHOD TO UPDATING AN ECHO CANCELLER IN A MULTICARRIER TRANSCIVER  | US | ABANDONED | 14/724,345      | 5/28/15 | US 2015-0288808 A1 |                 |          | 11/4/16  |
| 6936-3-PAU            | SYSTEM AND METHOD FOR THE APPLICATION OF AN LMS METHOD TO UPDATING AN ECHO CANCELLER COEFFICIENTS IN AN ADSL MODEM | AU | ABANDONED | 32943/01        | 1/25/01 | AU 3294301         | 783527          | 2/16/06  | 1/4/17   |
| 6936-3-PCA            | System and Method for the Application of an LMS Method to Updating an Echo Canceller in an ADSL Modem              | CA | ABANDONED | 2,396,162       | 1/25/01 | CA 2396162         |                 |          | 4/25/12  |
| 6936-3-PCT            | APPLICATION OF LMS METHOD TO UPDATING ECHO CANCELLER COEFFICIENTS IN ADSL MODEM                                    | WO | NAT PHASE | PCT/US01/02341  | 1/25/01 | WO 2001/056184     |                 |          |          |
| 6936-3-PEP            | APPLICATION OF LMS METHOD TO UPDATING ECHO CANCELLER COEFFICIENTS IN ADSL MODEM                                    | EP | ABANDONED | 01905022.8      | 1/25/01 | EP 1250766         | 1250766         | 9/17/08  | 12/12/19 |
| 6936-3-PEP-BE         | APPLICATION OF LMS METHOD TO UPDATING ECHO CANCELLER COEFFICIENTS IN ADSL MODEM                                    | BE | ABANDONED | 01905022.8      | 1/25/01 | N/A                | 1250766         | 9/17/08  | 12/12/19 |
| 6936-3-PEP-DE         | APPLICATION OF LMS METHOD TO UPDATING ECHO CANCELLER COEFFICIENTS IN ADSL MODEM                                    | DE | ABANDONED | 01905022.8      | 1/25/01 | N/A                | 1250766         | 9/17/08  | 12/12/19 |
| 6936-3-PEP-FR         | APPLICATION OF LMS METHOD TO UPDATING ECHO CANCELLER COEFFICIENTS IN ADSL MODEM                                    | FR | ABANDONED | 01905022.8      | 1/25/01 | N/A                | 1250766         | 9/17/08  | 12/12/19 |
| 6936-3-PEP-GB         | APPLICATION OF LMS METHOD TO UPDATING ECHO CANCELLER COEFFICIENTS IN ADSL MODEM                                    | GB | ABANDONED | 01905022.8      | 1/25/01 | N/A                | 1250766         | 9/17/08  | 12/12/19 |
| 6936-3-PEP-DIV        | System and Method for the Application of an LMS Method to Updating an Echo Canceller in an ADSL Modem              | EP | ABANDONED | 08015818.1      | 1/25/01 | 1 995 884          |                 |          | 1/25/21  |
| 6936-3-PEP-DIV-2      | System and Method for the Application of an LMS Method to Updating an Echo Canceller in an ADSL Modem              | EP | ABANDONED | 10011999.9      | 1/25/01 | 2267913            |                 |          | 1/25/21  |
| 6936-3-PIP            | APPLICATION OF LMS METHOD TO UPDATING ECHO CANCELLER COEFFICIENTS IN ADSL MODEM                                    | JP | ABANDONED | 2001-555226     | 1/25/01 | JP 2003-521194     |                 |          | 1/25/21  |
| 6936-3-PKR            | APPLICATION OF LMS METHOD TO UPDATING ECHO CANCELLER COEFFICIENTS IN ADSL MODEM                                    | KR | ABANDONED | 2002-7009465    | 1/25/01 | 10-2002-0069265    |                 |          | 1/25/21  |
| 6936-3-PKR-DIV        | APPLICATION OF LMS METHOD TO UPDATING ECHO CANCELLER COEFFICIENTS IN ADSL MODEM                                    | KR | ABANDONED | 10-2010-7006184 | 1/25/01 | 10-2010-0034063    |                 |          | 1/25/21  |
| 6936-3-PROV           | APPLICATION OF LMS METHOD TO UPDATING ECHO CANCELLER COEFFICIENTS IN ADSL MODEM                                    | US | EXPIRED   | 60/177,944      | 1/25/00 | N/A                |                 |          | 1/25/01  |

|                |                                                                                                                  |    |           |                |          |                    |            |          |          |
|----------------|------------------------------------------------------------------------------------------------------------------|----|-----------|----------------|----------|--------------------|------------|----------|----------|
| 6936-14        | SYSTEMS AND METHODS FOR MULTICARRIER MODULATION USING MULTI-TAP FREQUENCY-DOMAIN EQUALIZER AND DECISION FEEDBACK | US | ISSUED    | 10/211,425     | 8/2/02   | US 2003-0067865    | 6,760,373  | 7/6/04   | 8/2/22   |
| 6936-14-CDN    | SYSTEMS AND METHODS FOR MULTICARRIER MODULATION USING MULTI-TAP FREQUENCY-DOMAIN EQUALIZER AND DECISION FEEDBACK | US | ABANDONED | 10/834,193     | 4/29/04  | US 2004-0202239    |            |          | 8/2/22   |
| 6936-14-CDN-2  | Systems and Methods for Multicarrier Modulation Using Multi-Tap Frequency-Domain Equalizer and Decision Feedback | US | ISSUED    | 11/964,409     | 12/26/07 | US 2008-0101452 A1 | 7,656,976  | 2/2/10   | 8/2/22   |
| 6936-14-CDN-3  | SYSTEMS AND METHODS FOR MULTICARRIER MODULATION USING MULTI-TAP FREQUENCY-DOMAIN EQUALIZER AND DECISION FEEDBACK | US | ABANDONED | 12/640,838     | 12/17/09 | US 2010-0098149 A1 |            |          | 9/23/11  |
| 6936-14-CDN-4  | SYSTEMS AND METHODS FOR MULTICARRIER MODULATION USING MULTI-TAP FREQUENCY-DOMAIN EQUALIZER AND DECISION FEEDBACK | US | ABANDONED | 12/783,796     | 5/20/10  | US 2010-0296570 A1 |            |          | 3/2/11   |
| 6936-14-CDN-5  | SYSTEMS AND METHODS FOR MULTICARRIER MODULATION USING MULTI-TAP FREQUENCY-DOMAIN EQUALIZER AND DECISION FEEDBACK | US | ABANDONED | 12/783,801     | 5/20/10  | N/A                |            |          | 2/18/11  |
| 6936-14-PCT    | SYSTEMS AND METHOD FOR MULTICARRIER MODULATION USING MULTI-TAP FREQUENCY-DOMAIN EQUALIZER AND DECISION FEEDBACK  | WO | NAT PHASE | PCT/US02/24326 | 8/2/02   | WO 2003/012990     |            |          |          |
| 6936-14-PROV   | MULTICARRIER MODULATION METHOD USING MULTI-TAP FREQUENCY-DOMAIN EQUALIZATION AND DECISION FEEDBACK               | US | EXPIRED   | 60/309,631     | 8/2/01   | N/A                |            |          | 8/2/02   |
| 6936-19        | MULTI-CARRIER TRANSMITTER                                                                                        | US | EXPIRED   | 08/105,796     | 8/12/93  | N/A                | 5,497,398  | 3/5/96   | 8/12/13  |
| 6936-19-PCT    | MULTI-CARRIER TRANSMITTER                                                                                        | WO | NAT PHASE | PCT/US94/06713 | 6/13/94  | WO 1995/005711     |            |          |          |
| 6936-21        | SYSTEMS AND METHODS FOR IMPLEMENTING RECEIVER TRANSPARENT Q-MODE                                                 | US | ISSUED    | 10/106,329     | 3/27/02  | US 2002/0196861    | 6,731,695  | 5/4/04   | 3/27/21  |
| 6936-21-CDN    | SYSTEMS AND METHODS FOR IMPLEMENTING RECEIVER TRANSPARENT Q-MODE                                                 | US | ABANDONED | 10/802,867     | 3/18/04  | US 2004-0184552 A1 |            |          | 11/10/05 |
| 6936-21-CDN-2  | SYSTEMS AND METHODS FOR IMPLEMENTING RECEIVER TRANSPARENT Q-MODE                                                 | US | ABANDONED | 11/200,002     | 8/10/05  | US 2006-0039490 A1 |            |          | 8/7/06   |
| 6936-21-CDN-3  | SYSTEMS AND METHODS FOR IMPLEMENTING RECEIVER TRANSPARENT Q-MODE                                                 | US | ABANDONED | 11/434,249     | 5/16/06  | US 2006-0203927 A1 |            |          | 3/27/22  |
| 6936-21-CDN-4  | SYSTEMS AND METHODS FOR IMPLEMENTING RECEIVER TRANSPARENT Q-MODE                                                 | US | ISSUED    | 11/674,871     | 2/14/07  | US 2007-0147540 A1 | 7,558,329  | 7/7/09   | 3/27/22  |
| 6936-21-CDN-5  | Systems and Methods for Implementing Receiver Transparent Q-Mode                                                 | US | ABANDONED | 12/478,577     | 6/4/09   | US 2009-0290620 A1 |            |          | 7/25/11  |
| 6936-21-CDN-6  | Systems and Methods for Implementing Receiver Transparent Q-Mode                                                 | US | ISSUED    | 12/783,749     | 5/20/10  | US 2010-0290558 A1 | 8,335,271  | 12/18/12 | 3/27/22  |
| 6936-21-CDN-7  | Systems and Methods for Implementing Receiver Transparent Q-Mode                                                 | US | ABANDONED | 12/783,755     | 5/20/10  | US 2010-0296604 A1 |            |          | 3/27/22  |
| 6936-21-CDN-8  | Systems and Methods for Implementing Receiver Transparent Q-Mode                                                 | US | ISSUED    | 13/693,394     | 12/4/12  | US 2013-0094608 A1 | 8,792,574  | 7/29/14  | 3/27/22  |
| 6936-21-CDN-9  | RANDOMIZATION USING AN XOR SCRAMBLER IN MULTICARRIER COMMUNICATIONS                                              | US | ISSUED    | 14/308,934     | 6/19/14  | US 2014-0294116 A1 | 9,191,039  | 11/17/15 | 3/27/22  |
| 6936-21-CDN-10 | SYSTEMS AND METHODS FOR IMPLEMENTING RECEIVER TRANSPARENT Q-MODE                                                 | US | ABANDONED | 14/932,599     | 11/4/15  | US 2016-0056857 A1 |            |          | 11/14/17 |
| 6936-21-CDN-11 | SYSTEMS AND METHODS FOR IMPLEMENTING RECEIVER TRANSPARENT Q-MODE                                                 | US | ISSUED    | 15/812,705     | 11/14/17 | US 2018-0068590 A1 | 10,419,059 | 9/17/19  | 3/27/22  |
| 6936-21-PAU    | RECEIVER TRANSPARENT Q-MODE                                                                                      | AU | ABANDONED | 2002248711     | 3/27/02  | AU 2002248711      |            |          | 1/4/05   |
| 6936-21-PCA    | RECEIVER TRANSPARENT Q-MODE                                                                                      | CA | ABANDONED | 2,439,804      | 3/27/02  | CA 2439804         |            |          |          |
| 6936-21-PCT    | RECEIVER TRANSPARENT Q-MODE                                                                                      | WO | NAT PHASE | PCT/US02/09411 | 3/27/02  | WO02/078244        |            |          |          |
| 6936-21-PEP    | RECEIVER TRANSPARENT Q-MODE                                                                                      | EP | ABANDONED | 02717728.6     | 3/27/02  | EP1374469          |            |          | 11/2/04  |
| 6936-21-PPP    | RECEIVER TRANSPARENT Q-MODE                                                                                      | JP | ABANDONED | 2002-576356    | 3/27/02  | JP 2004-538676     |            |          | 3/10/05  |
| 6936-21-PRR    | RECEIVER TRANSPARENT Q-MODE                                                                                      | KR | ABANDONED | 2003-7012442   | 3/27/02  | 10-2004-0004562    |            |          |          |
| 6936-21-PROV-1 | RECEIVER TRANSPARENT Q-MODE                                                                                      | US | EXPIRED   | 60/278,936     | 3/27/01  | N/A                |            |          | 3/27/02  |
| 6936-21-PROV-2 | RECEIVER TRANSPARENT Q-MODE WITH ON-LINE RECONFIGURATION                                                         | US | EXPIRED   | 60/283,467     | 4/12/01  | N/A                |            |          | 4/12/02  |
| 6936-21-PROV-3 | RECEIVER TRANSPARENT Q-MODE WITH ON-LINE RECONFIGURATION AND SCRAMBLING                                          | US | EXPIRED   | 60/287,968     | 5/1/01   | N/A                |            |          | 5/1/02   |
| 6936-21-PROV-4 | RECEIVER TRANSPARENT Q-MODE WITH ON-LINE RECONFIGURATION, SCRAMBLING AND Q-MODE SYMBOL DISTORTION                | US | EXPIRED   | 60/293,034     | 5/23/01  | N/A                |            |          | 5/23/02  |
| 6936-22        | MULTI-CARRIER TRANSMISSION SYSTEM ADAPTED FOR PACKET DATA TRANSFER                                               | US | EXPIRED   | 08/670,245     | 6/19/96  | N/A                | 5,751,716  | 5/12/98  | 6/19/16  |
| 6936-22-PCT    | MULTI-CARRIER TRANSMISSION SYSTEM ADAPTED FOR PACKET DATA TRANSFER                                               | WO | NAT PHASE | PCT/US97/08736 | 5/17/97  | WO 1997/049208     |            |          |          |
| 6936-22-PEP    | MULTI-CARRIER TRANSMISSION SYSTEM ADAPTED FOR PACKET DATA TRANSFER                                               | EP | ABANDONED | 57925713.6     | 5/17/97  | N/A                |            |          | 9/5/00   |



|                     |                                                                                                              |    |           |                |          |                    |           |          |          |
|---------------------|--------------------------------------------------------------------------------------------------------------|----|-----------|----------------|----------|--------------------|-----------|----------|----------|
| 6936-23             | SYSTEMS AND METHODS THAT PROVIDE FREQUENCY DOMAIN SUPPLEMENTAL TRAINING OF THE TIME DOMAIN EQUALIZER FOR DMT | US | ISSUED    | 09/982,065     | 10/19/01 | US 2002-0057734    | 7,180,938 | 2/20/07  | 10/14/23 |
| 6936-23-CDN         | Systems and Methods That Provide Frequency Domain Supplemental Training of the Time Domain Equalizer for DMT | US | ABANDONED | 11/616,630     | 12/27/06 | US 2007-0104262    |           |          | 10/19/21 |
| 6936-23-CDN-2       | Systems and Methods That Provide Frequency Domain Supplemental Training of the Time Domain Equalizer for DMT | US | ABANDONED | 12/013,874     | 1/14/08  | US 2008-0107164 A1 | 7,636,389 | 12/22/09 | 3/14/17  |
| 6936-23-CDN-3       | Systems and Methods That Provide Frequency Domain Supplemental Training of the Time Domain Equalizer for DMT | US | ABANDONED | 12/615,077     | 11/9/09  | US 2010-0054321 A1 |           |          | 2/28/11  |
| 6936-23-CDN-4       | Systems and Methods That Provide Frequency Domain Supplemental Training of the Time Domain Equalizer for DMT | US | ISSUED    | 12/783,783     | 5/20/10  | US 2010-0290514 A1 | 8,102,909 | 1/24/12  | 10/19/21 |
| 6936-23-CDN-5       | Systems and Methods That Provide Frequency Domain Supplemental Training of the Time Domain Equalizer for DMT | US | ABANDONED | 12/783,788     | 5/20/10  | N/A                |           |          | 2/17/11  |
| 6936-23-CDN-6       | Systems and Methods That Provide Frequency Domain Supplemental Training of the Time Domain Equalizer for DMT | US | ABANDONED | 13/330,943     | 12/20/11 | US 2012-0087399 A1 |           |          | 9/19/13  |
| 6936-23-PCT         | SYSTEMS AND METHODS THAT PROVIDE FREQUENCY DOMAIN SUPPLEMENTAL TRAINING OF THE TIME DOMAIN EQUALIZER FOR DMT | WO | NAT PHASE | PCT/US01/32503 | 10/19/01 | WO 2002/038926     |           |          |          |
| 6936-23-PROV        | FREQUENCY DOMAIN SUPPLEMENTAL TRAINING OF THE TIME DOMAIN EQUALIZER FOR DMT                                  | US | EXPIRED   | 60/241,664     | 10/19/00 | N/A                |           |          | 10/19/01 |
| 6936-24             | MULTICARRIER TRANSMISSION SYSTEM                                                                             | US | EXPIRED   | 08/340,747     | 11/16/94 | N/A                | 5,636,246 | 6/3/97   | 11/16/14 |
| 6936-24-PAU         | MULTICARRIER TRANSMISSION SYSTEM                                                                             | AU | EXPIRED   | 41666/96       | 11/17/95 | AU 4166696         | 708318    | 11/11/99 | 11/17/15 |
| 6936-24-PCT         | MULTICARRIER TRANSMISSION SYSTEM                                                                             | WO | NAT PHASE | PCT/US95/15115 | 11/17/95 | WO 1997/026711     |           |          |          |
| 6936-24-PGB         | MULTICARRIER TRANSMISSION SYSTEM                                                                             | GB | EXPIRED   | 9709849.5      | 11/17/95 | GB 2320401         | 2320401   | 4/12/00  | 11/17/15 |
| 6936-25             | BIT ALLOCATION AMONG CARRIERS IN MULTICARRIER COMMUNICATIONS                                                 | US | EXPIRED   | 09/600,971     | 7/20/00  | N/A                | 6,870,888 | 3/22/05  | 11/23/19 |
| 6936-25-PAU         | ALLOCATION OF COMMUNICATION BITS AMONG CARRIERS IN MULTICARRIER COMMUNICATIONS                               | AU | ABANDONED | 18292/00       | 11/23/99 | AU 1829200         | 754597    | 3/6/03   | 11/22/16 |
| 6936-25-PAU-2       | ALLOCATION OF COMMUNICATION BITS AMONG CARRIERS IN MULTICARRIER COMMUNICATIONS                               | AU | ABANDONED | 2002302029     | 11/18/02 | AU 2002302029      |           |          | 11/19/03 |
| 6936-25-PCA         | ALLOCATION OF COMMUNICATION BITS AMONG CARRIERS IN MULTICARRIER COMMUNICATIONS                               | CA | ABANDONED | 2,350,916      | 11/23/99 | CA 2350916         | 2,350,916 | 11/20/07 | 9/25/17  |
| 6936-25-PCA-DIV     | Bit Allocation Among Carriers in Multicarrier Communications                                                 | CA | EXPIRED   | 2,599,805      | 11/23/99 | CA 2599805         | 2,599,805 | 9/29/09  | 11/23/19 |
| 6936-25-PCT         | ALLOCATION OF COMMUNICATION BITS AMONG CARRIERS IN MULTICARRIER COMMUNICATIONS                               | WO | NAT PHASE | PCT/US99/27798 | 11/23/99 | WO 2000/031940     |           |          |          |
| 6936-25-PEP         | ALLOCATION OF COMMUNICATION BITS AMONG CARRIERS IN MULTICARRIER COMMUNICATIONS                               | EP | EXPIRED   | 99961782.2     | 11/23/99 | 1133858            | 1133838   | 6/30/04  | 11/23/19 |
| 6936-25-PEPGB       | ALLOCATION OF COMMUNICATION BITS AMONG CARRIERS IN MULTICARRIER COMMUNICATIONS                               | GB | EXPIRED   | 99961782.2     | 11/23/99 | N/A                | 1133838   | 6/30/04  | 11/23/19 |
| 6936-25-PEP-2       | ALLOCATION OF COMMUNICATION BITS AMONG CARRIERS IN MULTICARRIER COMMUNICATIONS                               | EP | ABANDONED | 04012682.3     | 11/23/99 | 1453267            |           |          | 11/23/19 |
| 6936-25-PEP-2-DIV-1 | ALLOCATION OF COMMUNICATION BITS AMONG CARRIERS IN MULTICARRIER COMMUNICATIONS                               | EP | ABANDONED | 10011993.2     | 11/23/99 | 2264932            |           |          | 11/23/19 |
| 6936-25-PJP         | ALLOCATION OF COMMUNICATION BITS AMONG CARRIERS IN MULTICARRIER COMMUNICATIONS                               | JP | ABANDONED | 2000-584658    | 11/23/99 | 2002-531010        |           |          | 11/23/19 |
| 6936-25-PJP-DIV     | ALLOCATION OF COMMUNICATION BITS AMONG CARRIERS IN MULTICARRIER COMMUNICATIONS                               | JP | ABANDONED | 2010-56580     | 11/23/99 | 2010-141931        |           |          | 11/23/19 |
| 6936-25-PKR         | ALLOCATION OF COMMUNICATION BITS AMONG CARRIERS IN MULTICARRIER COMMUNICATIONS                               | KR | ABANDONED | 2001-7006580   | 11/23/99 | 10-2001-0101081    |           |          | 11/23/19 |
| 6936-25-PROV        | ALLOCATION OF COMMUNICATION BITS AMONG CARRIERS IN MULTICARRIER COMMUNICATIONS                               | US | EXPIRED   | 60/109,876     | 11/25/98 | N/A                |           |          | 11/25/99 |
| 6936-30             | MULTI-TAP FREQUENCY DOMAIN EQUALIZATION WITH DECISION FEEDBACK AND TRELLIS DECODING                          | US | ABANDONED | 10/631,745     | 8/1/03   | US 2004-0096008 A1 |           |          | 8/1/23   |
| 6936-30-DIV         | MULTI-TAP FREQUENCY DOMAIN EQUALIZATION WITH DECISION FEEDBACK AND TRELLIS DECODING                          | US | ABANDONED | 11/748,806     | 5/15/07  | US 2007-0211812    |           |          | 6/20/11  |
| 6936-30-DIV-CON     | MULTI-TAP FREQUENCY DOMAIN EQUALIZATION WITH DECISION FEEDBACK AND TRELLIS DECODING                          | US | ABANDONED | 12/783,733     | 5/20/10  | US 2010-0293442 A1 |           |          | 2/25/13  |
| 6936-30-DIV-CON-2   | MULTI-TAP FREQUENCY DOMAIN EQUALIZATION WITH DECISION FEEDBACK AND TRELLIS DECODING                          | US | ABANDONED | 12/783,737     | 5/20/10  | US 2010-0295582 A1 |           |          | 2/25/13  |

|              |                                                                                                              |    |           |                |          |                    |           |         |         |
|--------------|--------------------------------------------------------------------------------------------------------------|----|-----------|----------------|----------|--------------------|-----------|---------|---------|
| 6936-30-PCT  | COMBINED MULTI-TAP FREQUENCY DOMAIN EQUALIZATION WITH DECISION FEEDBACK AND TRELLIS DECODING                 | WO | NAT PHASE | PCT/US03/23965 | 8/1/03   | WO 2004/014032 A3  |           |         |         |
| 6936-30-PROV | COMBINED MULTI-TAP FREQUENCY DOMAIN EQUALIZATION WITH DECISION FEEDBACK AND TRELLIS DECODING                 | US | EXPIRED   | 60/400,550     | 8/1/02   | N/A                |           |         | 8/1/03  |
| 6936-36      | A SYSTEM AND METHOD FOR TRANSMITTING MESSAGES BETWEEN TRANSCEIVERS USING ELECTROMAGNETICALLY COUPLED SIGNALS | US | ISSUED    | 09/616,954     | 7/14/00  | N/A                | 6,748,016 | 6/8/04  | 7/5/22  |
| 6936-36-CDN  | SYSTEM AND METHOD FOR TRANSMITTING MESSAGES BETWEEN TRANSCEIVERS USING ELECTROMAGNETICALLY COUPLED SIGNALS   | US | ABANDONED | 10/743,946     | 12/24/03 | US 2004-0136463 A1 |           |         | 8/27/04 |
| 6936-36-PAU  | A SYSTEM AND METHOD FOR TRANSMITTING MESSAGES BETWEEN TRANSCEIVERS USING ELECTROMAGNETICALLY COUPLED SIGNALS | AU | ABANDONED | 59347/00       | 7/14/00  |                    |           |         | 1/13/05 |
| 6936-36-PCA  | A SYSTEM AND METHOD FOR TRANSMITTING MESSAGES BETWEEN TRANSCEIVERS USING ELECTROMAGNETICALLY COUPLED SIGNALS | CA | ABANDONED | 2378046        | 7/14/00  |                    |           |         | 1/13/05 |
| 6936-36-PCT  | A SYSTEM AND METHOD FOR TRANSMITTING MESSAGES BETWEEN TRANSCEIVERS USING ELECTROMAGNETICALLY COUPLED SIGNALS | WO | NAT PHASE | PCT/US00/19247 | 7/14/00  |                    |           |         |         |
| 6936-36-PEP  | A SYSTEM AND METHOD FOR TRANSMITTING MESSAGES BETWEEN TRANSCEIVERS USING ELECTROMAGNETICALLY COUPLED SIGNALS | EP | ABANDONED | 00945396.0     | 7/14/00  |                    |           |         | 1/13/05 |
| 6936-36-PJP  | A SYSTEM AND METHOD FOR TRANSMITTING MESSAGES BETWEEN TRANSCEIVERS USING ELECTROMAGNETICALLY COUPLED SIGNALS | JP | ABANDONED | 2001-511007    | 7/14/00  |                    |           |         | 1/13/05 |
| 6936-36-PKR  | A SYSTEM AND METHOD FOR TRANSMITTING MESSAGES BETWEEN TRANSCEIVERS USING ELECTROMAGNETICALLY COUPLED SIGNALS | KR | ABANDONED | 7000562/2002   | 7/14/00  |                    |           |         | 1/13/05 |
| 6936-36-PROV | A SYSTEM AND METHOD FOR TRANSMITTING MESSAGES BETWEEN TRANSCEIVERS USING ELECTROMAGNETICALLY COUPLED SIGNALS | US | EXPIRED   | 60/144,562     | 7/16/99  | N/A                |           |         | 7/16/00 |
| 6936-41      | MULTI-CARRIER TRANSMISSION SYSTEM UTILIZING CHANNELS WITH DIFFERENT ERROR RATES                              | US | EXPIRED   | 08/661,974     | 6/12/96  | N/A                | 5,832,090 | 11/3/98 | 6/12/16 |
| 6936-41-PCT  | MULTI-CARRIER TRANSMISSION SYSTEM UTILIZING CHANNELS WITH DIFFERENT ERROR RATES                              | WO | NAT PHASE | PCT/US97/08222 | 5/17/97  | WO 1997/48204      |           |         |         |
| 6936-45      | SINGLE SIDE-BAND MODULATION SYSTEM FOR USE IN DIGITALLY IMPLEMENTED MULTICARRIER TRANSMISSION SYSTEMS        | US | EXPIRED   | 08/591,831     | 1/25/96  | N/A                | 5,631,610 | 5/20/97 | 1/25/16 |
| 6936-45-PAU  | SINGLE SIDE-BAND MODULATION SYSTEM FOR USE IN DIGITALLY IMPLEMENTED MULTICARRIER TRANSMISSION SYSTEMS        | AU | EXPIRED   | 31342/97       | 5/17/97  | AU 3134297         | 738201    | 1/3/02  | 5/17/17 |
| 6936-45-PCA  | SINGLE SIDE-BAND MODULATION SYSTEM FOR USE IN DIGITALLY IMPLEMENTED MULTICARRIER TRANSMISSION SYSTEMS        | CA | ABANDONED | 2289537        | 5/17/97  |                    |           |         | 7/12/04 |
| 6936-45-PCT  | SINGLE SIDE-BAND MODULATION SYSTEM FOR USE IN DIGITALLY IMPLEMENTED MULTICARRIER TRANSMISSION SYSTEMS        | WO | NAT PHASE | PCT/US97/08549 | 5/17/97  | WO 1998/053552     |           |         |         |
| 6936-45-PEP  | SINGLE SIDE-BAND MODULATION SYSTEM FOR USE IN DIGITALLY IMPLEMENTED MULTICARRIER TRANSMISSION SYSTEMS        | EP | ABANDONED | 97926623.6     | 5/17/97  |                    |           |         | 3/27/03 |
| 6936-45-PJP  | SINGLE SIDE-BAND MODULATION SYSTEM FOR USE IN DIGITALLY IMPLEMENTED MULTICARRIER TRANSMISSION SYSTEMS        | JP | ABANDONED | 10-550313      | 5/17/97  |                    |           |         | 5/6/04  |
| 6936-46      | METHOD FOR PARTIALLY MODULATING AND DEMODULATING DATA IN A MULTICARRIER TRANSMISSION SYSTEM                  | US | EXPIRED   | 08/668,575     | 6/20/96  | N/A                | 5,715,280 | 2/3/98  | 6/20/16 |
| 6936-46-PAU  | METHOD FOR PARTIALLY MODULATING AND DEMODULATING DATA IN A MULTICARRIER TRANSMISSION SYSTEM                  | AU | EXPIRED   | 30673/97       | 5/17/97  | AU 3067397         | 743020    | 5/2/02  | 5/17/17 |
| 6936-46-PCA  | METHOD FOR PARTIALLY MODULATING AND DEMODULATING DATA IN A MULTICARRIER TRANSMISSION SYSTEM                  | CA | ABANDONED | 2289529        | 5/17/97  |                    |           |         | 6/17/03 |

|                     |                                                                                             |    |           |                 |          |                    |                  |         |          |
|---------------------|---------------------------------------------------------------------------------------------|----|-----------|-----------------|----------|--------------------|------------------|---------|----------|
| 6936-46-PCT         | METHOD FOR PARTIALLY MODULATING AND DEMODULATING DATA IN A MULTICARRIER TRANSMISSION SYSTEM | WO | NAT PHASE | PCT/US97/08209  | 5/17/97  | WO 1998/053572     |                  |         |          |
| 6936-46-PEP         | METHOD FOR PARTIALLY MODULATING AND DEMODULATING DATA IN A MULTICARRIER TRANSMISSION SYSTEM | EP | ABANDONED | 97925573.4      | 5/17/97  |                    |                  |         | 4/16/03  |
| 6936-46-PJP         | METHOD FOR PARTIALLY MODULATING AND DEMODULATING DATA IN A MULTICARRIER TRANSMISSION SYSTEM | JP | ABANDONED | 10-550306       | 5/17/97  |                    |                  |         | 5/13/04  |
| 6936-48             | INTELLIGENT RATE OPTION DETERMINATION METHOD APPLIED TO ADSL TRANSCIVER                     | US | ISSUED    | 09/738,785      | 12/15/00 | US 2001-0030998 A1 | 6,801,570        | 10/5/04 | 12/15/20 |
| 6936-48-PROV        | INTELLIGENT RATE OPTION DETERMINATION METHOD APPLIED TO ADSL TRANSCIVER                     | US | EXPIRED   | 60/172,343      | 12/16/99 | N/A                |                  |         | 12/16/00 |
| 6936-50             | SYSTEMS AND METHODS FOR LDPC CODED MODULATION                                               | US | ABANDONED | 09/882,046      | 6/18/01  | US 2002-0042899    |                  |         | 5/31/05  |
| 6936-50-DIV         | SYSTEMS AND METHODS FOR LDPC CODED MODULATION                                               | US | ABANDONED | 11/140,246      | 5/31/05  | US 2005-0229088 A1 |                  |         | 6/18/21  |
| 6936-50-DIV-2       | SYSTEMS AND METHODS FOR LDPC CODED MODULATION                                               | US | ABANDONED | 12/383,056      | 3/19/09  | US 2009-0183048 A1 |                  |         | 4/20/16  |
| 6936-50-DIV-2-CON   | SYSTEMS AND METHODS FOR LDPC CODED MODULATION                                               | US | ABANDONED | 12/783,825      | 5/20/10  | US 2010-0295573 A1 |                  |         | 5/30/11  |
| 6936-50-DIV-2-CON-2 | Systems and Methods for LDPC Coded Modulation                                               | US | ABANDONED | 12/783,839      | 5/20/10  | US 2010-0295574 A1 |                  |         | 6/1/11   |
| 6936-50-DIV-3       | SYSTEMS AND METHODS FOR LDPC CODED MODULATION                                               | US | ABANDONED | 15/077,506      | 3/22/16  | US 2016-0204901 A1 |                  |         | 1/13/17  |
| 6936-50-PAU         | SYSTEMS AND METHODS FOR LDPC CODED MODULATION                                               | AU | ABANDONED | 2001267096      | 6/18/01  | AU 2001267096      |                  |         | 3/28/06  |
| 6936-50-PCA         | SYSTEMS AND METHODS FOR LDPC CODED MODULATION                                               | CA | ABANDONED | 2,409,179       | 6/18/01  | CA 2409179         |                  |         | 2/24/11  |
| 6936-50-PCT         | SYSTEMS AND METHODS FOR LDPC CODED MODULATION                                               | WO | NAT PHASE | PCT/US01/41015  | 6/18/01  | WO 2001/097387     |                  |         |          |
| 6936-50-PEP         | SYSTEMS AND METHODS FOR LDPC CODED MODULATION                                               | EP | ABANDONED | 01944712.7      | 6/18/01  | EP 1290802         |                  |         |          |
| 6936-50-PJP         | SYSTEMS AND METHODS FOR LDPC CODED MODULATION                                               | JP | ABANDONED | 2002-511477     | 6/18/01  | 2004-503979        |                  |         | 10/27/11 |
| 6936-50-PKR         | SYSTEMS AND METHODS FOR LDPC CODED MODULATION                                               | KR | ABANDONED | 2002-7017148    | 6/18/01  | 10-2003-0036227    |                  |         | 6/18/21  |
| 6936-50-PKR-DIV     | SYSTEMS AND METHODS FOR LDPC CODED MODULATION                                               | KR | ABANDONED | 10-2010-7006498 | 6/18/01  | 10-2010-00469063   |                  |         | 6/18/21  |
| 6936-50-PROV        | LDPC CODED MODULATION LOW DENSITY PARITY CHECK (LDPC)                                       | US | EXPIRED   | 60/212,233      | 6/16/00  | N/A                |                  |         | 6/16/01  |
| 6936-50-PROV-2      | CODED MODULATION FOR ADSL                                                                   | US | EXPIRED   | 60/241,468      | 10/18/00 | N/A                |                  |         | 10/18/01 |
| 6936-60-PCA         | Stable Low Power Mode for Multicarrier Transceivers                                         | CA | ABANDONED | 2,706,362       | 11/21/08 | CA 2706362         |                  |         | 12/21/16 |
| 6936-60-PCN         | Stable Low Power Mode for Multicarrier Transceivers                                         | CN | ABANDONED | 200880117277.5  | 11/21/08 | CN101868951A       | ZL200880117277.5 | 9/7/16  | 9/20/17  |
| 6936-60-PCN-DIV     | Stable Low Power Mode for Multicarrier Transceivers                                         | CN | ABANDONED | 201310088357.5  | 11/21/08 | CN103227767        | ZL201310088357.5 | 4/12/17 | 9/20/17  |
| 6936-60-PCN-HK      | Stable Low Power Mode for Multicarrier Transceivers                                         | HK | ABANDONED | 10110838.3      | 11/21/08 | HK1144345          |                  |         | 12/12/16 |
| 6936-60-PCT         | Stable Low Power Mode for Multicarrier Transceivers                                         | WO | NAT PHASE | PCT/US08/84322  | 11/21/08 | WO 2009/067633     |                  |         |          |
| 6936-60-PEP         | Stable Low Power Mode for Multicarrier Transceivers                                         | EP | ABANDONED | 08852660.3      | 11/21/08 | EP 2223489         | 2223489          | 4/20/16 | 7/6/17   |
| 6936-60-PEP-DE      | Stable Low Power Mode for Multicarrier Transceivers                                         | DE | ABANDONED | 08852660.3      | 11/21/08 |                    | 2223489          | 4/20/16 | 7/6/17   |
| 6936-60-PEP-FR      | Stable Low Power Mode for Multicarrier Transceivers                                         | FR | ABANDONED | 08852660.3      | 11/21/08 |                    | 2223489          | 4/20/16 | 7/6/17   |
| 6936-60-PEP-GB      | Stable Low Power Mode for Multicarrier Transceivers                                         | GB | ABANDONED | 08852660.3      | 11/21/08 |                    | 2223489          | 4/20/16 | 7/6/17   |
| 6936-60-PEPHK       | Stable Low Power Mode for Multicarrier Transceivers                                         | HK | ABANDONED | 10109672.4      | 11/21/08 | HK 1143261         |                  |         | 2/11/16  |
| 6936-60-PIN         | Stable Low Power Mode for Multicarrier Transceivers                                         | IN | ABANDONED | 1800/KOLNP/2010 | 11/21/08 |                    |                  |         | 11/21/28 |
| 6936-60-PJP         | Stable Low Power Mode for Multicarrier Transceivers                                         | JP | ABANDONED | 2010-535086     | 11/21/08 | 2011-504709        |                  |         | 11/21/28 |
| 6936-60-PROV        | Stable Low Power Mode for Multicarrier Transceivers                                         | US | EXPIRED   | 60/989,542      | 11/21/07 | N/A                |                  |         | 11/21/08 |
| 6936-60-PUS         | Stable Low Power Mode for Multicarrier Transceivers                                         | US | ISSUED    | 12/739,330      | 8/12/10  | US 2010-0296555 A1 | 8,837,610        | 9/16/14 | 6/24/29  |
| 6936-60-PUS-CON     | Stable Low Power Mode for Multicarrier Transceivers                                         | US | ABANDONED | 14/485,937      | 9/15/14  | US 2015-0003504 A1 |                  |         | 5/10/16  |
| 6936-60-PUS-CON-2   | STABLE LOW POWER MODE FOR MULTICARRIER TRANSCIVERS                                          | US | ABANDONED | 15/084,788      | 3/30/16  | US 2016-0212275 A1 |                  |         | 6/7/17   |
| 6936-61-PROV        | Stable Low Power Mode for Multicarrier Transceivers (Second Edition)                        | US | EXPIRED   | 61/011,267      | 1/16/08  | N/A                |                  |         | 1/16/09  |
| 6936-84-PCT         | Reed-Solomon Erasure Decoding with Error Detection for Retransmission                       | WO | NAT PHASE | PCT/US10/37195  | 6/3/10   | WO 2010/141677     |                  |         |          |
| 6936-84-PROV        | Reed-Solomon Erasure Decoding with Error Detection for Retransmission                       | US | EXPIRED   | 61/183,845      | 6/3/09   | N/A                |                  |         | 6/3/10   |
| 6936-84-PUS         | Reed-Solomon Erasure Decoding with Error Detection for Retransmission                       | US | ISSUED    | 13/322,170      | 2/8/12   | US 2012-0144259 A1 | 8,782,498        | 7/15/14 | 11/15/30 |
| 6936-84-PUS-CON     | Reed-Solomon Erasure Decoding with Error Detection for Retransmission                       | US | ISSUED    | 14/328,237      | 7/10/14  | US 2014-0323306 A1 | 9,276,612        | 3/1/16  | 6/3/30   |
| 6936-84-PUS-CON-2   | REF-SOLOMON ERASURE DECODING WITH ERROR DETECTION FOR RETRANSMISSION                        | US | ABANDONED | 15/054,499      | 2/26/16  | US 2016-0182089 A1 |                  |         | 5/9/18   |
| 6936-85-PCA         | Low Power Mode with Legacy Compatibility                                                    | CA | PENDING   | 2,944,006       | 4/28/15  |                    |                  |         | 4/28/35  |
| 6936-85-PCT         | Low Power Mode with Legacy Compatibility                                                    | WO | NAT PHASE | PCT/US15/27983  | 4/28/15  | WO 2015/168117     |                  |         |          |

|                 |                                          |    |           |                 |          |                    |         |         |         |
|-----------------|------------------------------------------|----|-----------|-----------------|----------|--------------------|---------|---------|---------|
| 6936-85-PEP     | Low Power Mode with Legacy Compatibility | EP | ISSUED    | 15721495.8      | 4/28/15  | 3138206            | 3138206 | 6/10/20 | 4/28/35 |
| 6936-85-PEPDE   | Low Power Mode with Legacy Compatibility | DE | ISSUED    | 15721495.8      | 4/28/15  |                    | 3138206 | 6/10/20 | 4/28/35 |
| 6936-85-PEPFR   | Low Power Mode with Legacy Compatibility | FR | ISSUED    | 15721495.8      | 4/28/15  |                    | 3138206 | 6/10/20 | 4/28/35 |
| 6936-85-PEPGB   | Low Power Mode with Legacy Compatibility | GB | ISSUED    | 15721495.8      | 4/28/15  |                    | 3138206 | 6/10/20 | 4/28/35 |
| 6936-85-PEPNL   | Low Power Mode with Legacy Compatibility | NL | ISSUED    | 15721495.8      | 4/28/15  |                    | 3138206 | 6/10/20 | 4/28/35 |
| 6936-85-PEP-DIV | Low Power Mode with Legacy Compatibility | EP | ABANDONED | 20178740.5      | 4/28/15  |                    |         |         | 9/30/20 |
| 6936-85-PJP     | Low Power Mode with Legacy Compatibility | JP | ISSUED    | 2016-363176     | 4/28/15  | 2017-516391        | 6592006 | 9/27/19 | 4/28/35 |
| 6936-85-PKR     | Low Power Mode with Legacy Compatibility | KR | PENDING   | 10-2016-7029383 | 4/28/15  |                    |         |         | 4/28/35 |
| 6936-85-PROV    | Low Power Mode with Legacy Compatibility | US | EXPIRED   | 61/985,168      | 4/28/14  |                    |         |         | 4/28/15 |
| 6936-85-PUS     | LOW POWER MODE WITH LEGACY COMPATIBILITY | US | PUBLISHED | 15/304,920      | 10/18/16 | US 2017-0187512 A1 |         |         | 4/28/35 |

**Schedule III**

Copyrights

None

AO 120 (Rev. 08/10)

|                                                                                                                                                         |                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>TO:</b><br><b>Mail Stop 8</b><br><b>Director of the U.S. Patent and Trademark Office</b><br><b>P.O. Box 1450</b><br><b>Alexandria, VA 22313-1450</b> | <b>REPORT ON THE</b><br><b>FILING OR DETERMINATION OF AN</b><br><b>ACTION REGARDING A PATENT OR</b><br><b>TRADEMARK</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been  
filed in the U.S. District Court Transferred to Delaware from Alabama on the following

☐ Trademarks or ☒ Patents. ( ☐ the patent action involves 35 U.S.C. § 292.);

|                             |                                |                                                             |
|-----------------------------|--------------------------------|-------------------------------------------------------------|
| DOCKET NO.<br>15-cv-121-RGA | DATE FILED<br>7/17/2014        | U.S. DISTRICT COURT<br>Transferred to Delaware from Alabama |
| PLAINTIFF<br>ADTRAN, Inc.   |                                | DEFENDANT<br>TQ Delta, LLC                                  |
| PATENT OR<br>TRADEMARK NO.  | DATE OF PATENT<br>OR TRADEMARK | HOLDER OF PATENT OR TRADEMARK                               |
| 1 See Attachment #1         |                                |                                                             |
| 2                           |                                |                                                             |
| 3                           |                                |                                                             |
| 4                           |                                |                                                             |
| 5                           |                                |                                                             |

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

|                            |                                                                                                                                                                          |                               |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| DATE INCLUDED<br>3/13/2015 | INCLUDED BY<br><input type="checkbox"/> Amendment <input checked="" type="checkbox"/> Answer <input type="checkbox"/> Cross Bill <input type="checkbox"/> Other Pleading |                               |
| PATENT OR<br>TRADEMARK NO. | DATE OF PATENT<br>OR TRADEMARK                                                                                                                                           | HOLDER OF PATENT OR TRADEMARK |
| 1 See Attachment #2        |                                                                                                                                                                          |                               |
| 2                          |                                                                                                                                                                          |                               |
| 3                          |                                                                                                                                                                          |                               |
| 4                          |                                                                                                                                                                          |                               |
| 5                          |                                                                                                                                                                          |                               |

In the above—entitled case, the following decision has been rendered or judgement issued:

|                    |
|--------------------|
| DECISION/JUDGEMENT |
|--------------------|

|       |                   |      |
|-------|-------------------|------|
| CLERK | (BY) DEPUTY CLERK | DATE |
|-------|-------------------|------|

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director  
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

## Attachment #1

| Patent or Trademark No. | Date of Patent or Trademark | Holder of Patent or Trademark |
|-------------------------|-----------------------------|-------------------------------|
| 1.U.S. 7,453,881 B2     | 11/18/2008                  | TQ Delta, LLC                 |
| 2.U.S. 7,809,028 B2     | 10/05/2010                  | TQ Delta, LLC                 |
| 3.U.S. 7,978,706 B2     | 7/12/2011                   | TQ Delta, LLC                 |
| 4.U.S. 8,422,511 B2     | 4/16/2013                   | TQ Delta, LLC                 |
| 5.U.S. 6,445,730 B1     | 9/03/2002                   | TQ Delta, LLC                 |
| 6.U.S. 7,292,627 B2     | 11/6/2007                   | TQ Delta, LLC                 |
| 7.U.S. 7,451,379 B2     | 11/11/2008                  | TQ Delta, LLC                 |
| 8.U.S. 7,471,721 B2     | 12/30/2008                  | TQ Delta, LLC                 |
| 9.U.S. 7,570,686 B2     | 8/4/2009                    | TQ Delta, LLC                 |
| 10. U.S. 7,831,890 B2   | 11/09/2010                  | TQ Delta, LLC                 |
| 11. U.S. 7,835,430 B2   | 11/16/2010                  | TQ Delta, LLC                 |
| 12. U.S. 7,836,381 B1   | 11/16/2010                  | TQ Delta, LLC                 |
| 13. U.S. 7,844,882 B2   | 11/30/2010                  | TQ Delta, LLC                 |
| 14. U.S. 7,889,784 B2   | 2/15/2011                   | TQ Delta, LLC                 |
| 15. U.S. 7,925,958 B2   | 04/12/2011                  | TQ Delta, LLC                 |
| 16. U.S. 7,978,753 B2   | 07/12/2011                  | TQ Delta, LLC                 |
| 17. U.S. 7,979,778 B2   | 07/12/2011                  | TQ Delta, LLC                 |
| 18. U.S. 8,073,041 B1   | 12/6/2011                   | TQ Delta, LLC                 |
| 19. U.S. 8,090,008 B2   | 1/3/2012                    | TQ Delta, LLC                 |
| 20. U.S. 8,218,610 B2   | 7/10/2012                   | TQ Delta, LLC                 |
| 21. U.S. 8,238,412 B2   | 08/07/2012                  | TQ Delta, LLC                 |
| 22. U.S. 8,276,048 B2   | 09/25/2012                  | TQ Delta, LLC                 |
| 23. U.S. 8,355,427 B2   | 1/15/2013                   | TQ Delta, LLC                 |

|                       |            |               |
|-----------------------|------------|---------------|
| 24. U.S. 8,432,956 B2 | 4/30/2013  | TQ Delta, LLC |
| 25. U.S. 8,437,382 B2 | 5/7/2013   | TQ Delta, LLC |
| 26. U.S. 8,462,835 B2 | 6/11/2013  | TQ Delta, LLC |
| 27. U.S. 8,495,473 B2 | 7/23/2013  | TQ Delta, LLC |
| 28. U.S. 8,516,337 B2 | 08/20/2013 | TQ Delta, LLC |



|   | PATENT OR<br>TRADEMARK NO. | DATE OF PATENT<br>OR TRADEMARK | HOLDER OF PATENT OR TRADEMARK |
|---|----------------------------|--------------------------------|-------------------------------|
| 1 | US 7,796,705 B2            | 9/14/2010                      | TQ Delta, LLC                 |
| 2 | US 8,335,956 B2            | 12/18/2012                     | TQ Delta, LLC                 |
| 3 | US 8,407,546 B2            | 3/26/2013                      | TQ Delta, LLC                 |
| 4 | US 8,468,411 B2            | 6/18/2013                      | TQ Delta, LLC                 |
| 5 | US 8,645,784 B2            | 2/4/2014                       | TQ Delta, LLC                 |
| 6 | US 8,595,577 B2            | 11/26/2013                     | TQ Delta, LLC                 |

AO 120 (Rev. 08/10)

|                                                                                                                                                         |                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>TO:</b><br><b>Mail Stop 8</b><br><b>Director of the U.S. Patent and Trademark Office</b><br><b>P.O. Box 1450</b><br><b>Alexandria, VA 22313-1450</b> | <b>REPORT ON THE</b><br><b>FILING OR DETERMINATION OF AN</b><br><b>ACTION REGARDING A PATENT OR</b><br><b>TRADEMARK</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court District of Delaware on the following

☐ Trademarks or ☒ Patents. ( ☐ the patent action involves 35 U.S.C. § 292.):

|                            |                                |                                             |
|----------------------------|--------------------------------|---------------------------------------------|
| DOCKET NO.                 | DATE FILED<br>7/18/2014        | U.S. DISTRICT COURT<br>District of Delaware |
| PLAINTIFF<br>TQ Delta, LLC |                                | DEFENDANT<br>ADTRAN, Inc.                   |
| PATENT OR<br>TRADEMARK NO. | DATE OF PATENT<br>OR TRADEMARK | HOLDER OF PATENT OR TRADEMARK               |
| 1 See Attached             |                                |                                             |
| 2 32 Pts                   |                                |                                             |
| 3                          |                                |                                             |
| 4                          |                                |                                             |
| 5                          |                                |                                             |

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

|                            |                                                                                                                                                               |                               |  |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|--|
| DATE INCLUDED              | INCLUDED BY<br><input type="checkbox"/> Amendment <input type="checkbox"/> Answer <input type="checkbox"/> Cross Bill <input type="checkbox"/> Other Pleading |                               |  |
| PATENT OR<br>TRADEMARK NO. | DATE OF PATENT<br>OR TRADEMARK                                                                                                                                | HOLDER OF PATENT OR TRADEMARK |  |
| 1                          |                                                                                                                                                               |                               |  |
| 2                          |                                                                                                                                                               |                               |  |
| 3                          |                                                                                                                                                               |                               |  |
| 4                          |                                                                                                                                                               |                               |  |
| 5                          |                                                                                                                                                               |                               |  |

In the above—entitled case, the following decision has been rendered or judgement issued:

|                    |                   |      |
|--------------------|-------------------|------|
| DECISION/JUDGEMENT |                   |      |
| CLERK              | (BY) DEPUTY CLERK | DATE |

Copy 1—Upon initiation of action, mail this copy to Director    Copy 3—Upon termination of action, mail this copy to Director  
 Copy 2—Upon filing document adding patent(s), mail this copy to Director    Copy 4—Case file copy

|    | PATENT OR<br>TRADEMARK NO. | DATE OF PATENT<br>OR TRADEMARK | HOLDER OF PATENT OR TRADEMARK |
|----|----------------------------|--------------------------------|-------------------------------|
| 1  | US 8,090,008 B2            | 1/3/2012                       | TQ Delta, LLC                 |
| 2  | US 8,073,041 B1            | 12/6/2011                      | TQ Delta, LLC                 |
| 3  | US 7,292,627 B2            | 11/6/2007                      | TQ Delta, LLC                 |
| 4  | US 7,471,721 B2            | 12/30/2008                     | TQ Delta, LLC                 |
| 5  | US 8,218,610 B2            | 7/10/2012                      | TQ Delta, LLC                 |
| 6  | US 8,355,427 B2            | 1/15/2013                      | TQ Delta, LLC                 |
| 7  | US 7,453,881 B2            | 11/18/2008                     | TQ Delta, LLC                 |
| 8  | US 7,809,028 B2            | 10/5/2010                      | TQ Delta, LLC                 |
| 9  | US 7,978,706 B2            | 7/12/2011                      | TQ Delta, LLC                 |
| 10 | US 8,422,511 B2            | 4/16/2013                      | TQ Delta, LLC                 |
| 11 | US 7,889,784 B2            | 2/15/2011                      | TQ Delta, LLC                 |
| 12 | US 7,835,430 B2            | 11/16/2010                     | TQ Delta, LLC                 |
| 13 | US 7,570,686 B2            | 8/4/2009                       | TQ Delta, LLC                 |
| 14 | US 8,238,412 B2            | 8/7/2012                       | TQ Delta, LLC                 |
| 15 | US 8,432,956 B2            | 4/30/2013                      | TQ Delta, LLC                 |
| 16 | US 7,451,379 B2            | 11/11/2008                     | TQ Delta, LLC                 |
| 17 | US 8,516,337 B2            | 8/20/2013                      | TQ Delta, LLC                 |
| 18 | US 7,979,778 B2            | 7/12/2011                      | TQ Delta, LLC                 |
| 19 | US 7,925,958 B2            | 4/12/2011                      | TQ Delta, LLC                 |
| 20 | US 8,462,835 B2            | 6/11/2013                      | TQ Delta, LLC                 |
| 21 | US 8,594,162 B2            | 11/26/2013                     | TQ Delta, LLC                 |
| 22 | US 7,978,753 B2            | 7/12/2011                      | TQ Delta, LLC                 |
| 23 | US 6,445,730 B1            | 9/3/2002                       | TQ Delta, LLC                 |
| 24 | US 8,611,404 B2            | 12/17/2013                     | TQ Delta, LLC                 |
| 25 | US 8,437,382 B2            | 5/7/2013                       | TQ Delta, LLC                 |
| 26 | US 7,836,381 B1            | 11/16/2010                     | TQ Delta, LLC                 |
| 27 | US 7,844,882 B2            | 11/30/2010                     | TQ Delta, LLC                 |
| 28 | US 8,276,048 B2            | 9/25/2012                      | TQ Delta, LLC                 |
| 29 | US 8,495,473 B2            | 7/23/2013                      | TQ Delta, LLC                 |
| 30 | US 8,607,126 B1            | 12/10/2013                     | TQ Delta, LLC                 |
| 31 | US 7,831,890 B2            | 11/9/2010                      | TQ Delta, LLC                 |
| 32 | US 8,625,660 B2            | 1/7/2014                       | TQ Delta, LLC                 |

**Birch, Melvin (Akima)**

---

**From:** ded\_nefreply@ded.uscourts.gov  
**Sent:** Wednesday, November 20, 2013 4:56 PM  
**To:** ded\_ecf@ded.uscourts.gov  
**Subject:** Activity in Case 1:13-cv-01835-RGA TQ Delta LLC v. Pace Americas Inc.  
Patent/Trademark Report to Commissioner

This is an automatic e-mail message generated by the CM/ECF system. Please **DO NOT RESPOND** to this e-mail because the mail box is unattended.

\*\*\*NOTE TO PUBLIC ACCESS USERS\*\*\* Judicial Conference of the United States policy permits attorneys of record and parties in a case (including pro se litigants) to receive one free electronic copy of all documents filed electronically, if receipt is required by law or directed by the filer. PACER access fees apply to all other users. To avoid later charges, download a copy of each document during this first viewing. However, if the referenced document is a transcript, the free copy and 30 page limit do not apply.

U.S. District Court

District of Delaware

**Notice of Electronic Filing**

The following transaction was entered by Farnan, Brian on 11/20/2013 at 4:56 PM EST and filed on 11/20/2013

**Case Name:** TQ Delta LLC v. Pace Americas Inc.

**Case Number:** 1:13-cv-01835-RGA

**Filer:**

**Document Number:** 7

**Docket Text:**

**Report to the Commissioner of Patents and Trademarks for Patent/Trademark Number(s) US 8,090,008 B2; US 8,073,041 B1; US 7,292,627 B2; US 7,471,721 B2; US 8,218,610 B2; US 8,355,427 B2; US 7,453,881 B2; US 7,978,706 B2; US 8,422,511 B2; US 7,889,784 B2; US 7,835,430 B2; US 7,570,686 B2; US 8,238,412 B2; US 8,432,956 B2; US 7,451,379 B2; US 8,516,337 B2; US 7,979,778 B2; US 7,925,958 B2; US 8,462,835 B2; US 7,836,381 B1; US 7,844,882 B2; US 8,276,048 B2; US 8,495,473 B2; US 7,831,890 B2; . (Farnan, Brian)**

**1:13-cv-01835-RGA Notice has been electronically mailed to:**

Brian E. Farnan [bfarnan@farnanlaw.com](mailto:bfarnan@farnanlaw.com), [tfarnan@farnanlaw.com](mailto:tfarnan@farnanlaw.com)

Michael J. Farnan [mfarnan@farnanlaw.com](mailto:mfarnan@farnanlaw.com), [tfarnan@farnanlaw.com](mailto:tfarnan@farnanlaw.com)

**1:13-cv-01835-RGA Filer will deliver document by other means to:**

The following document(s) are associated with this transaction:

**From:** ded\_nefreply@ded.uscourts.gov  
**Sent:** Wednesday, November 20, 2013 5:07 PM  
**To:** ded\_ecf@ded.uscourts.gov  
**Subject:** Activity in Case 1:13-cv-01836-RGA TQ Delta LLC v. Zhone Technologies Inc.  
Patent/Trademark Report to Commissioner

This is an automatic e-mail message generated by the CM/ECF system. Please **DO NOT RESPOND** to this e-mail because the mail box is unattended.

**\*\*\*NOTE TO PUBLIC ACCESS USERS\*\*\*** Judicial Conference of the United States policy permits attorneys of record and parties in a case (including pro se litigants) to receive one free electronic copy of all documents filed electronically, if receipt is required by law or directed by the filer. PACER access fees apply to all other users. To avoid later charges, download a copy of each document during this first viewing. However, if the referenced document is a transcript, the free copy and 30 page limit do not apply.

**U.S. District Court**

**District of Delaware**

**Notice of Electronic Filing**

The following transaction was entered by Farnan, Brian on 11/20/2013 at 5:07 PM EST and filed on 11/20/2013

**Case Name:** TQ Delta LLC v. Zhone Technologies Inc.

**Case Number:** 1:13-cv-01836-RGA

**Filer:**

**Document Number:** 7

**Docket Text:**

**Report to the Commissioner of Patents and Trademarks for Patent/Trademark Number(s) US 8,090,008 B2; US 8,073,041 B1; US 7,292,627 B2; US 7,471,721 B2; US 8,218,610 B2; US 8,355,427 B2; US 7,453,881 B2; US 7,809,028 B2; US 7,978,706 B2; US 8,422,511 B2; US 7,796,705 B2; US 7,889,784 B2; US 7,835,430 B2; US 7,570,686 B2; US 8,238,412 B2; US 8,432,956 B2; US 7,451,379 B2; US 8,516,337 B2; US 7,979,778 B2; US 7,925,958 B2; US 8,462,835 B2; US 7,978,753 B2; US 6,445,730 B1; US 8,437,382 B2; US 7,836,381 B1; US 7,844,882 B2; US 8,276,048 B2; US 8,495,473 B2; US 7,831,890 B2; US 8,335,956 B2; US 8,468,411 B2; US 8,407,546 B2 . (Farnan, Brian)**

**1:13-cv-01836-RGA Notice has been electronically mailed to:**

Brian E. Farnan [bfarnan@farnanlaw.com](mailto:bfarnan@farnanlaw.com), [tfarnan@farnanlaw.com](mailto:tfarnan@farnanlaw.com)

Michael J. Farnan [mfarnan@farnanlaw.com](mailto:mfarnan@farnanlaw.com), [tfarnan@farnanlaw.com](mailto:tfarnan@farnanlaw.com)

**1:13-cv-01836-RGA Filer will deliver document by other means to:**

AO 120 (Rev. 08/10)

|                                                                                                                                               |                                                                                                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>TO: Mail Stop 8</b><br><b>Director of the U.S. Patent and Trademark Office</b><br><b>P.O. Box 1450</b><br><b>Alexandria, VA 22313-1450</b> | <b>REPORT ON THE</b><br><b>FILING OR DETERMINATION OF AN</b><br><b>ACTION REGARDING A PATENT OR</b><br><b>TRADEMARK</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court District of Delaware on the following  
☐ Trademarks or ☒ Patents. ( ☐ the patent action involves 35 U.S.C. § 292.);

|                            |                             |                                                                              |
|----------------------------|-----------------------------|------------------------------------------------------------------------------|
| DOCKET NO.                 | DATE FILED<br>12/9/2013     | U.S. DISTRICT COURT<br>District of Delaware                                  |
| PLAINTIFF<br>TQ Delta, LLC |                             | DEFENDANT<br>ZyXEL Communications Corporation and ZyXEL Communications, Inc. |
| PATENT OR TRADEMARK NO.    | DATE OF PATENT OR TRADEMARK | HOLDER OF PATENT OR TRADEMARK                                                |
| 1 See Attached             |                             |                                                                              |
| 2                          |                             |                                                                              |
| 3                          |                             |                                                                              |
| 4                          |                             |                                                                              |
| 5                          |                             |                                                                              |

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

|                         |                                                                                                                                                               |                               |  |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|--|
| DATE INCLUDED           | INCLUDED BY<br><input type="checkbox"/> Amendment <input type="checkbox"/> Answer <input type="checkbox"/> Cross Bill <input type="checkbox"/> Other Pleading |                               |  |
| PATENT OR TRADEMARK NO. | DATE OF PATENT OR TRADEMARK                                                                                                                                   | HOLDER OF PATENT OR TRADEMARK |  |
| 1                       |                                                                                                                                                               |                               |  |
| 2                       |                                                                                                                                                               |                               |  |
| 3                       |                                                                                                                                                               |                               |  |
| 4                       |                                                                                                                                                               |                               |  |
| 5                       |                                                                                                                                                               |                               |  |

In the above—entitled case, the following decision has been rendered or judgement issued:

|                    |                   |      |
|--------------------|-------------------|------|
| DECISION/JUDGEMENT |                   |      |
| CLERK              | (BY) DEPUTY CLERK | DATE |

Copy 1—Upon initiation of action, mail this copy to Director    Copy 3—Upon termination of action, mail this copy to Director  
Copy 2—Upon filing document adding patent(s), mail this copy to Director    Copy 4—Case file copy

|    | PATENT OR<br>TRADEMARK NO. | DATE OF PATENT<br>OR TRADEMARK | HOLDER OF PATENT OR TRADEMARK |
|----|----------------------------|--------------------------------|-------------------------------|
| 1  | US 8,090,008 B2            | 1/3/2012                       | TQ Delta, LLC                 |
| 2  | US 8,073,041 B1            | 12/6/2011                      | TQ Delta, LLC                 |
| 3  | US 7,292,627 B2            | 11/6/2007                      | TQ Delta, LLC                 |
| 4  | US 7,471,721 B2            | 12/30/2008                     | TQ Delta, LLC                 |
| 5  | US 8,218,610 B2            | 7/10/2012                      | TQ Delta, LLC                 |
| 6  | US 8,355,427 B2            | 1/15/2013                      | TQ Delta, LLC                 |
| 7  | US 7,453,881 B2            | 11/18/2008                     | TQ Delta, LLC                 |
| 8  | US 7,809,028 B2            | 10/5/2010                      | TQ Delta, LLC                 |
| 9  | US 7,978,706 B2            | 7/12/2011                      | TQ Delta, LLC                 |
| 10 | US 8,422,511 B2            | 4/16/2013                      | TQ Delta, LLC                 |
| 11 | US 7,796,705 B2            | 9/14/2010                      | TQ Delta, LLC                 |
| 12 | US 7,889,784 B2            | 2/15/2011                      | TQ Delta, LLC                 |
| 13 | US 7,835,430 B2            | 11/16/2010                     | TQ Delta, LLC                 |
| 14 | US 7,570,686 B2            | 8/4/2009                       | TQ Delta, LLC                 |
| 15 | US 8,238,412 B2            | 8/7/2012                       | TQ Delta, LLC                 |
| 16 | US 8,432,956 B2            | 4/30/2013                      | TQ Delta, LLC                 |
| 17 | US 7,451,379 B2            | 11/11/2008                     | TQ Delta, LLC                 |
| 18 | US 8,516,337 B2            | 8/20/2013                      | TQ Delta, LLC                 |
| 19 | US 7,979,778 B2            | 7/12/2011                      | TQ Delta, LLC                 |
| 20 | US 7,925,958 B2            | 4/12/2011                      | TQ Delta, LLC                 |
| 21 | US 8,462,835 B2            | 6/11/2013                      | TQ Delta, LLC                 |
| 22 | US 7,978,753 B2            | 7/12/2011                      | TQ Delta, LLC                 |
| 23 | US 6,445,730 B1            | 9/3/2002                       | TQ Delta, LLC                 |
| 24 | US 8,437,382 B2            | 5/7/2013                       | TQ Delta, LLC                 |
| 25 | US 7,836,381 B1            | 11/16/2010                     | TQ Delta, LLC                 |
| 26 | US 7,844,882 B2            | 11/30/2010                     | TQ Delta, LLC                 |
| 27 | US 8,276,048 B2            | 9/25/2012                      | TQ Delta, LLC                 |
| 28 | US 8,495,473 B2            | 7/23/2013                      | TQ Delta, LLC                 |
| 29 | US 7,831,890 B2            | 11/9/2010                      | TQ Delta, LLC                 |
| 30 | US 8,335,956 B2            | 12/18/2012                     | TQ Delta, LLC                 |
| 31 | US 8,468,411 B2            | 6/18/2013                      | TQ Delta, LLC                 |
| 32 | US 8,407,546 B2            | 3/26/2013                      | TQ Delta, LLC                 |

|                                                                                                                                                         |                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>TO:</b><br><b>Mail Stop 8</b><br><b>Director of the U.S. Patent and Trademark Office</b><br><b>P.O. Box 1450</b><br><b>Alexandria, VA 22313-1450</b> | <b>REPORT ON THE</b><br><b>FILING OR DETERMINATION OF AN</b><br><b>ACTION REGARDING A PATENT OR</b><br><b>TRADEMARK</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Northern District of Texas, Dallas Division on the following

☒ Trademarks or ☐ Patents. ( ☐ the patent action involves 35 U.S.C. § 292.):

|                              |                                |                                                                    |
|------------------------------|--------------------------------|--------------------------------------------------------------------|
| DOCKET NO.<br>3:12-cv-1462-L | DATE FILED<br>5/10/2012        | U.S. DISTRICT COURT<br>Northern District of Texas, Dallas Division |
| PLAINTIFF<br>Boulle Ltd      |                                | DEFENDANT<br>De Boulle Diamond & Jewelry Inc                       |
| PATENT OR<br>TRADEMARK NO.   | DATE OF PATENT<br>OR TRADEMARK | HOLDER OF PATENT OR TRADEMARK                                      |
| 1 4,086,050                  | 1/17/2012                      | Boulle Ltd                                                         |
| 2                            |                                |                                                                    |
| 3                            |                                |                                                                    |
| 4                            |                                |                                                                    |
| 5                            |                                |                                                                    |

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

|                            |                                                                                                                                                                          |                                 |  |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|--|
| DATE INCLUDED<br>12/9/2013 | INCLUDED BY<br><input checked="" type="checkbox"/> Amendment <input type="checkbox"/> Answer <input type="checkbox"/> Cross Bill <input type="checkbox"/> Other Pleading |                                 |  |
| PATENT OR<br>TRADEMARK NO. | DATE OF PATENT<br>OR TRADEMARK                                                                                                                                           | HOLDER OF PATENT OR TRADEMARK   |  |
| 1 3,078,625                | 4/11/2006                                                                                                                                                                | De Boulle Diamond & Jewelry Inc |  |
| 2 3,078,627                | 4/11/2006                                                                                                                                                                | De Boulle Diamond & Jewelry Inc |  |
| 3                          |                                                                                                                                                                          |                                 |  |
| 4                          |                                                                                                                                                                          |                                 |  |
| 5                          |                                                                                                                                                                          |                                 |  |

In the above—entitled case, the following decision has been rendered or judgement issued:

|                         |                                           |                    |
|-------------------------|-------------------------------------------|--------------------|
| DECISION/JUDGEMENT      |                                           |                    |
| CLERK<br>Karen Mitchell | (BY) DEPUTY CLERK<br>s/A. Lowe-Monserrate | DATE<br>12/10/2013 |

Copy 1—Upon initiation of action, mail this copy to Director    Copy 3—Upon termination of action, mail this copy to Director  
 Copy 2—Upon filing document adding patent(s), mail this copy to Director    Copy 4—Case file copy





UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

| APPLICATION NUMBER | FILING OR 371(C) DATE | FIRST NAMED APPLICANT | ATTY. DOCKET NO./TITLE |
|--------------------|-----------------------|-----------------------|------------------------|
| 11/246,163         | 10/11/2005            | Marcos C. Tzannes     | 6936-54                |

**CONFIRMATION NO. 5478**

**POA ACCEPTANCE LETTER**



62574  
Jason H. Vick  
Sheridan Ross, PC  
Suite # 1200  
1560 Broadway  
Denver, CO 80202

Date Mailed: 11/27/2012

**NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY**

This is in response to the Power of Attorney filed 11/08/2012.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/hchristian/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

| APPLICATION NUMBER | FILING OR 371(C) DATE | FIRST NAMED APPLICANT | ATTY. DOCKET NO./TITLE |
|--------------------|-----------------------|-----------------------|------------------------|
| 11/246,163         | 10/11/2005            | Marcos C. Tzannes     | 6936-54                |

CONFIRMATION NO. 5478

POWER OF ATTORNEY NOTICE



OC000000057768265

62574  
Jason H. Vick  
Sheridan Ross, PC  
Suite # 1200  
1560 Broadway  
Denver, CO 80202

Date Mailed: 11/27/2012

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 11/08/2012.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

/hchristian/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

**POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO**

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:



Practitioners associated with Customer Number:

62574

OR



Practitioner(s) named below (If more than ten patent practitioners are to be named, then a customer number must be used):

| Name | Registration Number | Name | Registration Number |
|------|---------------------|------|---------------------|
|      |                     |      |                     |
|      |                     |      |                     |
|      |                     |      |                     |
|      |                     |      |                     |
|      |                     |      |                     |

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignments documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:



The address associated with Customer Number:

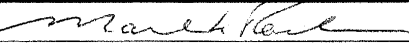
62574

OR

|                          |                         |       |     |  |
|--------------------------|-------------------------|-------|-----|--|
| <input type="checkbox"/> | Firm or Individual Name |       |     |  |
|                          | Address                 |       |     |  |
|                          | City                    | State | Zip |  |
|                          | Country                 |       |     |  |
|                          | Telephone               | Email |     |  |

Assignee Name and Address: TQ DELTA, LLC  
805 Las Cimas Parkway, Suite 240  
Austin, Texas 78746**A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be Filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of The practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.****SIGNATURE of Assignee of Record**

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

|           |                                                                                     |           |              |
|-----------|-------------------------------------------------------------------------------------|-----------|--------------|
| Signature |  | Date      | 10/4/12      |
| Name      | Mark K. Roche                                                                       | Telephone | 512-609-1810 |
| Title     | Managing Director                                                                   |           |              |

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

| Electronic Acknowledgement Receipt   |                                                      |
|--------------------------------------|------------------------------------------------------|
| EFS ID:                              | 14185926                                             |
| Application Number:                  | 11246163                                             |
| International Application Number:    |                                                      |
| Confirmation Number:                 | 5478                                                 |
| Title of Invention:                  | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT |
| First Named Inventor/Applicant Name: | Marcos C. Tzannes                                    |
| Customer Number:                     | 62574                                                |
| Filer:                               | Jason Vick/Joanne Vos                                |
| Filer Authorized By:                 | Jason Vick                                           |
| Attorney Docket Number:              | 6936-54                                              |
| Receipt Date:                        | 08-NOV-2012                                          |
| Filing Date:                         | 11-OCT-2005                                          |
| Time Stamp:                          | 18:05:44                                             |
| Application Type:                    | Utility under 35 USC 111(a)                          |

**Payment information:**

| Submitted with Payment | no                   |                             |                                                    |                  |                  |
|------------------------|----------------------|-----------------------------|----------------------------------------------------|------------------|------------------|
| <b>File Listing:</b>   |                      |                             |                                                    |                  |                  |
| Document Number        | Document Description | File Name                   | File Size(Bytes)/<br>Message Digest                | Multi Part /.zip | Pages (if appl.) |
| 1                      |                      | EntityStatus_373c_w_POA.pdf | 416983<br>b944db81c862b6537aa657c06f3bbd2c702f8323 | yes              | 4                |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Multipart Description/PDF files in .zip description |        |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|--------|-----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Document Description                                | Start  | End |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Miscellaneous Incoming Letter                       | 1      | 1   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Assignee showing of ownership per 37 CFR 3.73.      | 2      | 3   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Power of Attorney                                   | 4      | 4   |
| <b>Warnings:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                     |        |     |
| <b>Information:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                     |        |     |
| Total Files Size (in bytes):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                     | 416983 |     |
| <p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><b><u>New Applications Under 35 U.S.C. 111</u></b><br/>If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><b><u>National Stage of an International Application under 35 U.S.C. 371</u></b><br/>If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><b><u>New International Application Filed with the USPTO as a Receiving Office</u></b><br/>If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p> |                                                     |        |     |

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

|                                             |                                  |
|---------------------------------------------|----------------------------------|
| In Re the Application of: Marcos C. Tzannes | ) Issued Patent No.: 7,831,890   |
| Application No.: 11/246,163                 | ) Issued Date: November 9, 2010  |
| Filed: October 11, 2005                     | ) Examiner: PFIZENMAYER, Mark C. |
| Atty. File No.: 6936-54                     | ) Confirmation No.: 5478         |

For: RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT

**ASSERTION OF ENTITLEMENT TO SMALL ENTITY STATUS**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Madam:

In accordance with MPEP §§ 509.02 and 509.03 and 37 CFR 1.27, this document is being filed to inform the U.S. Patent Office of the change of status for the above-identified patent from large entity status to small entity status. All fees paid to date have been paid as large entity status. No fees have yet been paid as small entity status. Due to the sale of the referenced patent, the Applicant is now entitled to small entity status.

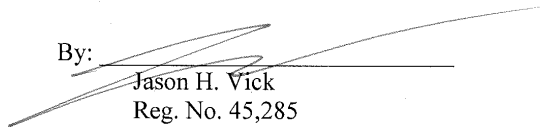
We respectfully request that small entity status be granted for the above-referenced patent.

Please contact the undersigned if there are any questions regarding this notification.

Respectfully submitted,

SHERIDAN ROSS P.C.

Date: 8 Nov 12

By:   
Jason H. Vick  
Reg. No. 45,285  
1560 Broadway, Suite 1200  
Denver, Colorado 80202  
Telephone: 303-863-9700

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

**STATEMENT UNDER 37 CFR 3.73(c)**Applicant/Patent Owner: TQ DELTA, LLCApplication No./Patent No.: 7,831,890 Filed/Issue Date: November 9, 2010Titled: RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENTTQ DELTA, LLC, a Corporation

(Name of Assignee)

(Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose one of options 1, 2, 3 or 4 below):

1. ☒ The assignee of the entire right, title, and interest.
2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):
- ☐ The extent (by percentage) of its ownership interest is \_\_\_\_%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.
- ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (e.g., bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose one of options A or B below):

- A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel \_\_\_\_\_, Frame \_\_\_\_\_, or for which a copy thereof is attached.
- B. ☒ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: Marcos C. Tzannes, Michael Lund To: AWARE, INC.

The document was recorded in the United States Patent and Trademark Office at

Reel 017438, Frame 0094, or for which a copy thereof is attached.2. From: AWARE, INC. To: TQ DELTA, LLC

The document was recorded in the United States Patent and Trademark Office at

Reel 029154, Frame 0937, or for which a copy thereof is attached.

[Page 1 of 2]

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

**STATEMENT UNDER 37 CFR 3.73(c)**

3. From: \_\_\_\_\_ To: \_\_\_\_\_

The document was recorded in the United States Patent and Trademark Office at  
Reel \_\_\_\_\_, Frame \_\_\_\_\_, or for which a copy thereof is attached.

4. From: \_\_\_\_\_ To: \_\_\_\_\_

The document was recorded in the United States Patent and Trademark Office at  
Reel \_\_\_\_\_, Frame \_\_\_\_\_, or for which a copy thereof is attached.

5. From: \_\_\_\_\_ To: \_\_\_\_\_

The document was recorded in the United States Patent and Trademark Office at  
Reel \_\_\_\_\_, Frame \_\_\_\_\_, or for which a copy thereof is attached.

6. From: \_\_\_\_\_ To: \_\_\_\_\_

The document was recorded in the United States Patent and Trademark Office at  
Reel \_\_\_\_\_, Frame \_\_\_\_\_, or for which a copy thereof is attached.☐ Additional documents in the chain of title are listed on a supplemental sheet(s).☒ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

Signature

Jason H. Vick

Printed or Typed Name

Date

45,285

Title or Registration Number

[Page 2 of 2]



UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : 7,831,890 B2  
APPLICATION NO. : 11/246163  
DATED : November 9, 2010  
INVENTOR(S) : Marcos C. Tzannes et al.

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

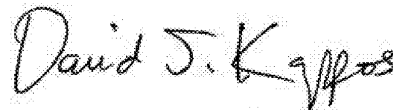
In the claims:

In column 11, claim 5, line 18, delete "transmission" and insert -- reception --

In column 12, claim 5, line 3, delete "received" and insert -- transmitted --

In column 12, claim 5, line 8, delete "shred" and insert -- shared --

Signed and Sealed this  
Eighth Day of February, 2011

A handwritten signature in black ink, reading "David J. Kappos". The signature is written in a cursive, flowing style with a large initial "D".

David J. Kappos  
*Director of the United States Patent and Trademark Office*

**SPE RESPONSE FOR CERTIFICATE OF CORRECTION**

Paper No.: \_\_\_\_\_

**DATE** : 01/11/11

**TO SPE OF** : ART UNIT: **2447 Attn: HWANG JOON H (SPE)**

**SUBJECT** : Request for Certificate of Correction for Appl. No.: 11/246163 Patent No.: 7831890

CofC Mailroom date: 01/05/11

Please respond to this request for a certificate of correction within 7 days.

**FOR IFW FILES:**

Please review the requested changes/corrections as shown in the **COCIN** document(s) in the IFW application image. No new matter should be introduced, nor should the scope or meaning of the claims be changed.

Please complete the response (see below) and forward the completed response to scanning using document code **COCX**.

**FOR PAPER FILES:**

Please review the requested changes/corrections as shown in the attached certificate of correction. Please complete this form (see below) and forward it with the file to:

**Certificates of Correction Branch (CofC)**  
**Randolph Square – 9D10-A**  
**Palm Location 7580**

**Tasneem Siddiqui**  
 Certificates of Correction Branch  
 703-756-1593 or 703-756-1814

**Thank You For Your Assistance**

**The request for issuing the above-identified correction(s) is hereby:**

Note your decision on the appropriate box.

☒ **Approved**

All changes apply.

☐ **Approved in Part**

Specify below which changes **do not** apply.

☐ **Denied**

State the reasons for denial below.

**Comments:** Approved

\_\_\_\_\_  
 \_\_\_\_\_

/Joon H. Hwang/

**SPE**

2447

**Art Unit**

UNITED STATES PATENT AND TRADEMARK OFFICE  
CERTIFICATE OF CORRECTION

Page 1 of 1

PATENT NO. : 7,831,890 *B2*  
APPLICATION NO.: 11/246,163  
ISSUE DATE : November 9, 2010  
INVENTOR(S) : Marcos C. Tzannes et al.

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

*IN THE CLAIMS:*

In column 11, claim 5, line 18, delete "transmission" and insert -- reception --

In column 12, claim 5, line 3, delete "received" and insert -- transmitted --

In column 12, claim 5, line 8, delete "shred" and insert -- shared --

MAILING ADDRESS OF SENDER (Please do not use customer number below):

Jason H. Vick c/o Sheridan Ross, PC  
1560 Broadway, Suite 1200  
Denver, CO 80202

This collection of information is required by 37 CFR 1.322, 1.323, and 1.324. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1.0 hour to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Attention Certificate of Corrections Branch, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

**SPE RESPONSE FOR CERTIFICATE OF CORRECTION**

Paper No.: \_\_\_\_\_

DATE : 01/11/11

TO SPE OF : ART UNIT: 2447 Attn: HWANG JOON H (SPE)

SUBJECT : Request for Certificate of Correction for Appl. No.: 11/246163 Patent No.: 7831890

CofC Mailroom date: 01/05/11

Please respond to this request for a certificate of correction within 7 days.

**FOR IFW FILES:**

Please review the requested changes/corrections as shown in the **COCIN** document(s) in the IFW application image. No new matter should be introduced, nor should the scope or meaning of the claims be changed.

Please complete the response (see below) and forward the completed response to scanning using document code **COCX**.

**FOR PAPER FILES:**

Please review the requested changes/corrections as shown in the attached certificate of correction. Please complete this form (see below) and forward it with the file to:

**Certificates of Correction Branch (CofC)**  
**Randolph Square – 9D10-A**  
**Palm Location 7580**

**Tasneem Siddiqui**  
**Certificates of Correction Branch**  
**703-756-1593 or 703-756-1814**

**Thank You For Your Assistance**

**The request for issuing the above-identified correction(s) is hereby:**

Note your decision on the appropriate box.

☐ **Approved**

All changes apply.

☐ **Approved in Part**

Specify below which changes **do not** apply.

☐ **Denied**

State the reasons for denial below.

**Comments:** \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
**SPE**

\_\_\_\_\_  
**Art Unit**

UNITED STATES PATENT AND TRADEMARK OFFICE  
CERTIFICATE OF CORRECTION

Page 1 of 1

PATENT NO. : 7,831,890 *B2*  
APPLICATION NO.: 11/246,163  
ISSUE DATE : November 9, 2010  
INVENTOR(S) : Marcos C. Tzannes et al.

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

*IN THE CLAIMS:*

In column 11, claim 5, line 18, delete "transmission" and insert -- reception --

In column 12, claim 5, line 3, delete "received" and insert -- transmitted --

In column 12, claim 5, line 8, delete "shred" and insert -- shared --

MAILING ADDRESS OF SENDER (Please do not use customer number below):

Jason H. Vick c/o Sheridan Ross, PC  
1560 Broadway, Suite 1200  
Denver, CO 80202

This collection of information is required by 37 CFR 1.322, 1.323, and 1.324. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1.0 hour to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Attention Certificate of Corrections Branch, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of: Marcos C. Tzannes

Application No.: 11/246,163

Patent No.: 7,831,890

Issued: November 9, 2010

Confirmation No.: 5478

Atty. File No.: 5550-54

For: RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT

**REQUEST FOR CERTIFICATE OF CORRECTION OF PATENT FOR  
OFFICE'S MISTAKE (37 C.F.R. §1.322) AND APPLICANT'S MISTAKE (37 C.F.R. §1.323)**

Attn: Certificate of Corrections Branch  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

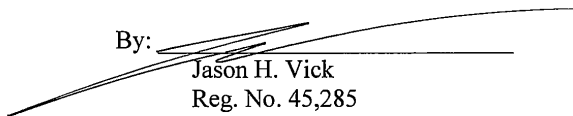
This is a request for a Certificate of Correction under 37 C.F.R. 1.322 and 1.323 for the above-identified patent. Attached is form PTO/SB/44. Applicants have determined that there were typographic errors in claim 5 which were the mistake of both the Office and the Applicant. The corrections do not introduce new matter, do not require re-examination, and do not materially affect the scope or meaning of the patent.

Payment in the amount of \$100.00, as required by 37 C.F.R. § 1.20(a) is being submitted herewith. Although no additional fees are believed due in connection with the filing of this paper, please charge any additional fees deemed necessary or credit any overpayment to Deposit Account No. 19-1970.

Respectfully submitted,

SHERIDAN ROSS P.C.

Date: 5 Jan '11

By: 

Jason H. Vick  
Reg. No. 45,285  
1560 Broadway, Suite 1200  
Denver, Colorado 80202  
Telephone: 303-863-9700

**UNITED STATES PATENT AND TRADEMARK OFFICE  
CERTIFICATE OF CORRECTION**

Page 1 of 1

PATENT NO. : 7,831,890  
APPLICATION NO.: 11/246,163  
ISSUE DATE : November 9, 2010  
INVENTOR(S) : Marcos C. Tzannes et al.

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In column 11, claim 5, line 18, delete "transmission" and insert -- reception --

In column 12, claim 5, line 3, delete "received" and insert -- transmitted --

In column 12, claim 5, line 8, delete "shred" and insert -- shared --

**MAILING ADDRESS OF SENDER (Please do not use customer number below):**

Jason H. Vick c/o Sheridan Ross, PC  
1560 Broadway, Suite 1200  
Denver, CO 80202

This collection of information is required by 37 CFR 1.322, 1.323, and 1.324. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1.0 hour to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Attention Certificate of Corrections Branch, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

*If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.*



| Electronic Patent Application Fee Transmittal  |                 |                                                      |               |                             |
|------------------------------------------------|-----------------|------------------------------------------------------|---------------|-----------------------------|
| <b>Application Number:</b>                     |                 | 11246163                                             |               |                             |
| <b>Filing Date:</b>                            |                 | 11-Oct-2005                                          |               |                             |
| <b>Title of Invention:</b>                     |                 | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT |               |                             |
| <b>First Named Inventor/Applicant Name:</b>    |                 | Marcos C. Tzannes                                    |               |                             |
| <b>Filer:</b>                                  |                 | Jason Vick/Joanne Vos                                |               |                             |
| <b>Attorney Docket Number:</b>                 |                 | 5550-54                                              |               |                             |
| Filed as Large Entity                          |                 |                                                      |               |                             |
| <b>Utility under 35 USC 111(a) Filing Fees</b> |                 |                                                      |               |                             |
| <b>Description</b>                             | <b>Fee Code</b> | <b>Quantity</b>                                      | <b>Amount</b> | <b>Sub-Total in USD(\$)</b> |
| <b>Basic Filing:</b>                           |                 |                                                      |               |                             |
| <b>Pages:</b>                                  |                 |                                                      |               |                             |
| <b>Claims:</b>                                 |                 |                                                      |               |                             |
| <b>Miscellaneous-Filing:</b>                   |                 |                                                      |               |                             |
| <b>Petition:</b>                               |                 |                                                      |               |                             |
| <b>Patent-Appeals-and-Interference:</b>        |                 |                                                      |               |                             |
| <b>Post-Allowance-and-Post-Issuance:</b>       |                 |                                                      |               |                             |
| Certificate of correction                      | 1811            | 1                                                    | 100           | 100                         |
| <b>Extension-of-Time:</b>                      |                 |                                                      |               |                             |

| Description       | Fee Code | Quantity | Amount | Sub-Total in USD(\$) |
|-------------------|----------|----------|--------|----------------------|
| Miscellaneous:    |          |          |        |                      |
| Total in USD (\$) |          |          |        | 100                  |

| Electronic Acknowledgement Receipt   |                                                      |
|--------------------------------------|------------------------------------------------------|
| EFS ID:                              | 9172791                                              |
| Application Number:                  | 11246163                                             |
| International Application Number:    |                                                      |
| Confirmation Number:                 | 5478                                                 |
| Title of Invention:                  | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT |
| First Named Inventor/Applicant Name: | Marcos C. Tzannes                                    |
| Customer Number:                     | 62574                                                |
| Filer:                               | Jason Vick/Joanne Vos                                |
| Filer Authorized By:                 | Jason Vick                                           |
| Attorney Docket Number:              | 5550-54                                              |
| Receipt Date:                        | 05-JAN-2011                                          |
| Filing Date:                         | 11-OCT-2005                                          |
| Time Stamp:                          | 18:12:11                                             |
| Application Type:                    | Utility under 35 USC 111(a)                          |

**Payment information:**

|                                                                                                                                                                                                                    |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Submitted with Payment                                                                                                                                                                                             | yes             |
| Payment Type                                                                                                                                                                                                       | Deposit Account |
| Payment was successfully received in RAM                                                                                                                                                                           | \$100           |
| RAM confirmation Number                                                                                                                                                                                            | 7865            |
| Deposit Account                                                                                                                                                                                                    | 191970          |
| Authorized User                                                                                                                                                                                                    |                 |
| <p>The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:</p> <p>Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)</p> |                 |

| File Listing:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                       |                                           |                                          |                  |                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-------------------------------------------|------------------------------------------|------------------|------------------|
| Document Number                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Document Description                  | File Name                                 | File Size(Bytes)/ Message Digest         | Multi Part /.zip | Pages (if appl.) |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Request for Certificate of Correction | Request_For_Certificate_of_Correction.pdf | 74065                                    | no               | 3                |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                       |                                           | 3a3c18c563e7e7e78aa44ae240b4f55ac63c9a   |                  |                  |
| Warnings:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                       |                                           |                                          |                  |                  |
| Information:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                       |                                           |                                          |                  |                  |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Fee Worksheet (PTO-875)               | fee-info.pdf                              | 29681                                    | no               | 2                |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                       |                                           | 840faee51128a5eb6ff1017cc9b99a2b72b81b04 |                  |                  |
| Warnings:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                       |                                           |                                          |                  |                  |
| Information:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                       |                                           |                                          |                  |                  |
| Total Files Size (in bytes):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                       |                                           | 103746                                   |                  |                  |
| <p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><b><u>New Applications Under 35 U.S.C. 111</u></b><br/>If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><b><u>National Stage of an International Application under 35 U.S.C. 371</u></b><br/>If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><b><u>New International Application Filed with the USPTO as a Receiving Office</u></b><br/>If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p> |                                       |                                           |                                          |                  |                  |



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
[www.uspto.gov](http://www.uspto.gov)

| APPLICATION NO. | ISSUE DATE | PATENT NO. | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|------------|------------|---------------------|------------------|
| 11/246,163      | 11/09/2010 | 7831890    | 5550-54             | 5478             |
| 62574           | 7590       | 10/20/2010 |                     |                  |

Jason H. Vick  
Sheridan Ross, PC  
Suite # 1200  
1560 Broadway  
Denver, CO 80202

**ISSUE NOTIFICATION**

The projected patent number and issue date are specified above.

**Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)**  
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 1123 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site <http://pair.uspto.gov> for additional applicants):

Marcos C. Tzannes, Orinda, CA;  
Michael Lund, West Newton, MA;

**PART B - FEE(S) TRANSMITTAL**

Complete and send this form, together with applicable fee(s), to: **Mail Stop ISSUE FEE**  
**Commissioner for Patents**  
**P.O. Box 1450**  
**Alexandria, Virginia 22313-1450**  
 or Fax **(571)-273-2885**

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

62574 7590 09/07/2010

Jason H. Vick  
 Sheridan Ross, PC  
 Suite # 1200  
 1560 Broadway  
 Denver, CO 80202

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

**Certificate of Mailing or Transmission**

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

|                    |
|--------------------|
| (Depositor's name) |
| (Signature)        |
| (Date)             |

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 11/246,163      | 10/11/2005  | Marcos C. Tzannes    | 5550-54             | 5478             |

TITLE OF INVENTION: RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT

| APPLN. TYPE         | SMALL ENTITY | ISSUE FEE DUE  | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE   |
|---------------------|--------------|----------------|---------------------|----------------------|------------------|------------|
| nonprovisional      | NO           | \$1510         | \$300               | \$0                  | \$1810           | 12/07/2010 |
| EXAMINER            | ART UNIT     | CLASS-SUBCLASS |                     |                      |                  |            |
| PFIZENMAYER, MARK C | 2447         | 714-774000     |                     |                      |                  |            |

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).  
☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.  
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list  
 (1) the names of up to 3 registered patent attorneys or agents OR, alternatively,  
 (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.  
 1 Jason H. Vick  
 2 Sheridan Ross, P.C.  
 3 \_\_\_\_\_

**3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)**

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Aware, Inc.

Bedford, MA

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government

**4a. The following fee(s) are submitted:**

- ☒ Issue Fee  
☒ Publication Fee (No small entity discount permitted)  
☐ Advance Order - # of Copies \_\_\_\_\_

**4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)**

- ☐ A check is enclosed.  
☐ Payment by credit card. Form PTO-2038 is attached.  
☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number 191970 (enclose an extra copy of this form).

**5. Change in Entity Status (from status indicated above)**

- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature \_\_\_\_\_  
 Typed or printed name Jason H. Vick

Date 4 Oct '10  
 Registration No. 45,285

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

|                                             |   |                                |
|---------------------------------------------|---|--------------------------------|
| In Re the Application of: Marcos C. Tzannes | ) | Group Art Unit: 2447           |
|                                             | ) |                                |
| Application No.: 11/246,163                 | ) | Examiner: Pfizenmayer, Mark C. |
|                                             | ) |                                |
| Filed: October 11, 2005                     | ) | Confirmation No.: 5478         |
|                                             | ) |                                |
| Atty. File No.: 5550-54                     | ) |                                |
|                                             | ) |                                |

For: RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT

**COMMENTS ON STATEMENT OF REASONS FOR ALLOWANCE**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313

Sir:

Applicant submits this Comments on Statement of Reasons for Allowance to address further the Notice of Allowability ("Notice") having a mailing date of September 7, 2010.

In the Notice, the Examiner's stated reasons for allowance were that:

Claim 46 identifies the distinct features of specifying a maximum number of bytes available to be allocated to an interleaver in a transmitted or received message, determining the amount of memory required by the interleaver, and then allocating the bytes of a shared memory to the interleaver wherein the bytes allocated do not exceed the maximum number of available bytes specified in the message.

The closest prior art, Fadavi-Ardekani et al (U.S. Pat. No. 6,707,822) discloses sharing a memory between the interleavers and deinterleavers of multiple ADSL sessions, fails to suggest limiting the memory allocated to the interleaver to a maximum number of bytes available that was specified in a transmitted or received message. The above features in conjunction with all other limitations of the dependent and independent claims 46-49 are hereby allowed.

Claim 50 identifies the distinct features of specifying a maximum number of bytes available to be allocated to a deinterleaver in a transmitted or received message, determining the amount of memory required by the deinterleaver, and then allocating the bytes of a shared memory to the deinterleaver wherein the bytes allocated do not exceed the maximum number of available bytes specified in the message.

The closest prior art, Fadavi-Ardekani et al (U.S. Pat. No. 6,707,822) discloses sharing a memory between the interleavers and deinterleavers of multiple ADSL sessions, fails to suggest limiting the memory allocated to the deinterleaver to a maximum number of bytes available that was specified in a transmitted or received message. The above features in conjunction with all other limitations of the dependent and independent claims 50-53 are hereby allowed.

Based on the Notice, the patentability of all other independent and dependent claims is assumed to be based upon the elements as set forth in such claims and that such claims meet all criteria for patentability under §101, §102, §103 and §112.

As is clear from MPEP 1302.14,

“The statement [of reasons for allowance] is not intended to necessarily state all the reasons for allowance or all the details why claims are allowed and should not be written to specifically or impliedly state that all the reasons for allowance are set forth.”

While the stated Reasons for Allowance may be a stated reason for allowing some independent claims, Applicant submits that some independent claims have a different reason for allowance and that some independent claims have other reasons for allowance.

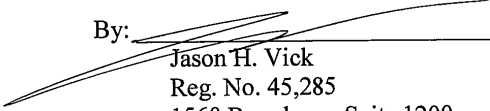
Specifically, the prior art fails to teach the specific combination of features as recited in the independent claims 46 and 50.

Although the Applicant believes that no fees are due for filing this Comments on Statement of Reasons for Allowance, please charge any fees deemed necessary to Deposit Account No. 19-1970.

Respectfully submitted,

SHERIDAN ROSS P.C.

Date: 4 Oct 10

By: 

Jason H. Vick  
Reg. No. 45,285  
1560 Broadway, Suite 1200  
Denver, Colorado 80202  
Telephone: 303-863-9700



| Electronic Patent Application Fee Transmittal  |                 |                                                      |               |                             |
|------------------------------------------------|-----------------|------------------------------------------------------|---------------|-----------------------------|
| <b>Application Number:</b>                     |                 | 11246163                                             |               |                             |
| <b>Filing Date:</b>                            |                 | 11-Oct-2005                                          |               |                             |
| <b>Title of Invention:</b>                     |                 | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT |               |                             |
| <b>First Named Inventor/Applicant Name:</b>    |                 | Marcos C. Tzannes                                    |               |                             |
| <b>Filer:</b>                                  |                 | Jason Vick/Joanne Vos                                |               |                             |
| <b>Attorney Docket Number:</b>                 |                 | 5550-54                                              |               |                             |
| Filed as Large Entity                          |                 |                                                      |               |                             |
| <b>Utility under 35 USC 111(a) Filing Fees</b> |                 |                                                      |               |                             |
| <b>Description</b>                             | <b>Fee Code</b> | <b>Quantity</b>                                      | <b>Amount</b> | <b>Sub-Total in USD(\$)</b> |
| <b>Basic Filing:</b>                           |                 |                                                      |               |                             |
| <b>Pages:</b>                                  |                 |                                                      |               |                             |
| <b>Claims:</b>                                 |                 |                                                      |               |                             |
| <b>Miscellaneous-Filing:</b>                   |                 |                                                      |               |                             |
| <b>Petition:</b>                               |                 |                                                      |               |                             |
| <b>Patent-Appeals-and-Interference:</b>        |                 |                                                      |               |                             |
| <b>Post-Allowance-and-Post-Issuance:</b>       |                 |                                                      |               |                             |
| Utility Appl issue fee                         | 1501            | 1                                                    | 1510          | 1510                        |
| Publ. Fee- early, voluntary, or normal         | 1504            | 1                                                    | 300           | 300                         |

| Description        | Fee Code | Quantity | Amount | Sub-Total in USD(\$) |
|--------------------|----------|----------|--------|----------------------|
| Extension-of-Time: |          |          |        |                      |
| Miscellaneous:     |          |          |        |                      |
| Total in USD (\$)  |          |          |        | 1810                 |

| Electronic Acknowledgement Receipt          |                                                      |
|---------------------------------------------|------------------------------------------------------|
| <b>EFS ID:</b>                              | 8557762                                              |
| <b>Application Number:</b>                  | 11246163                                             |
| <b>International Application Number:</b>    |                                                      |
| <b>Confirmation Number:</b>                 | 5478                                                 |
| <b>Title of Invention:</b>                  | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT |
| <b>First Named Inventor/Applicant Name:</b> | Marcos C. Tzannes                                    |
| <b>Customer Number:</b>                     | 62574                                                |
| <b>Filer:</b>                               | Jason Vick/Joanne Vos                                |
| <b>Filer Authorized By:</b>                 | Jason Vick                                           |
| <b>Attorney Docket Number:</b>              | 5550-54                                              |
| <b>Receipt Date:</b>                        | 04-OCT-2010                                          |
| <b>Filing Date:</b>                         | 11-OCT-2005                                          |
| <b>Time Stamp:</b>                          | 18:52:22                                             |
| <b>Application Type:</b>                    | Utility under 35 USC 111(a)                          |

### Payment information:

|                                                                                                                                                                                                                                                                                                                                                                                          |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Submitted with Payment                                                                                                                                                                                                                                                                                                                                                                   | yes             |
| Payment Type                                                                                                                                                                                                                                                                                                                                                                             | Deposit Account |
| Payment was successfully received in RAM                                                                                                                                                                                                                                                                                                                                                 | \$1810          |
| RAM confirmation Number                                                                                                                                                                                                                                                                                                                                                                  | 5484            |
| Deposit Account                                                                                                                                                                                                                                                                                                                                                                          | 191970          |
| Authorized User                                                                                                                                                                                                                                                                                                                                                                          |                 |
| <p>The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:</p> <p>Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)</p> <p>Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)</p> |                 |

| Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                         |                       |                                                        |                  |                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-----------------------|--------------------------------------------------------|------------------|------------------|
| Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                         |                       |                                                        |                  |                  |
| Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                         |                       |                                                        |                  |                  |
| <b>File Listing:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                         |                       |                                                        |                  |                  |
| Document Number                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Document Description                    | File Name             | File Size(Bytes)/<br>Message Digest                    | Multi Part /.zip | Pages (if appl.) |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                         | Issue_Fee_Payment.pdf | 349265<br><br>744b02c1ad64f82ada5fed915e01c6302b508a5c | yes              | 3                |
| <b>Multipart Description/PDF files in .zip description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                         |                       |                                                        |                  |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Document Description</b>             |                       | <b>Start</b>                                           | <b>End</b>       |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Issue Fee Payment (PTO-85B)             |                       | 1                                                      | 1                |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Post Allowance Communication - Incoming |                       | 2                                                      | 3                |                  |
| <b>Warnings:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                         |                       |                                                        |                  |                  |
| <b>Information:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                         |                       |                                                        |                  |                  |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Fee Worksheet (PTO-875)                 | fee-info.pdf          | 31704<br><br>def7650a6d2d1ec7cfa2d312f397c2e081207b13  | no               | 2                |
| <b>Warnings:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                         |                       |                                                        |                  |                  |
| <b>Information:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                         |                       |                                                        |                  |                  |
| <b>Total Files Size (in bytes):</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                         |                       | 380969                                                 |                  |                  |
| <p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><b><u>New Applications Under 35 U.S.C. 111</u></b><br/>         If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><b><u>National Stage of an International Application under 35 U.S.C. 371</u></b><br/>         If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><b><u>New International Application Filed with the USPTO as a Receiving Office</u></b><br/>         If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p> |                                         |                       |                                                        |                  |                  |

UNITED STATES PATENT AND TRADEMARK OFFICE  
COMMISSIONER FOR PATENTS  
P.O. BOX 1450  
ALEXANDRIA VA 22313-1451

PRESORTED  
FIRST-CLASS MAIL  
U.S. POSTAGE PAID  
POSTEDIGITAL  
NNNNN

Jason H. Vick  
Sheridan Ross, PC  
Suite # 1200  
1560 Broadway  
Denver, CO 80202



**Courtesy Reminder for  
Application Serial No: 11/246,163**

Attorney Docket No: 5550-54

Customer Number: 62574

Date of Electronic Notification: 09/07/2010

This is a courtesy reminder that new correspondence is available for this application. The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

An email notification regarding the correspondence was sent to the following email address(es) associated with your customer number:

jvick@sheridanross.com

Please verify that these email addresses are correct.

To view your correspondence online or update your email addresses, please visit us anytime at <https://spportal.uspto.gov/secure/myportal/privatepair>. If you have any questions, please email the Electronic Business Center (EBC) at [EBC@uspto.gov](mailto:EBC@uspto.gov) or call 1-866-217-9197.



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

62574 7590 09/07/2010  
Jason H. Vick  
Sheridan Ross, PC  
Suite # 1200  
1560 Broadway  
Denver, CO 80202

EXAMINER  
PFIZENMAYER, MARK C

ART UNIT PAPER NUMBER  
2447

DATE MAILED: 09/07/2010

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 11/246,163      | 10/11/2005  | Marcos C. Tzannes    | 5550-54             | 5478             |

TITLE OF INVENTION: RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT

| APPLN. TYPE    | SMALL ENTITY | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE   |
|----------------|--------------|---------------|---------------------|----------------------|------------------|------------|
| nonprovisional | NO           | \$1510        | \$300               | \$0                  | \$1810           | 12/07/2010 |

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. **PROSECUTION ON THE MERITS IS CLOSED.** THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN **THREE MONTHS** FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. **THIS STATUTORY PERIOD CANNOT BE EXTENDED.** SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

- A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.
- B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

- A. Pay TOTAL FEE(S) DUE shown above, or
- B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

**IMPORTANT REMINDER:** Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: **Mail Stop ISSUE FEE**  
**Commissioner for Patents**  
**P.O. Box 1450**  
**Alexandria, Virginia 22313-1450**  
or **Fax (571)-273-2885**

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

62574 7590 09/07/2010

Jason H. Vick  
Sheridan Ross, PC  
Suite # 1200  
1560 Broadway  
Denver, CO 80202

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

|                    |
|--------------------|
| (Depositor's name) |
| (Signature)        |
| (Date)             |

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 11/246,163      | 10/11/2005  | Marcos C. Tzannes    | 5550-54             | 5478             |

TITLE OF INVENTION: RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT

| APPLN. TYPE    | SMALL ENTITY | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE   |
|----------------|--------------|---------------|---------------------|----------------------|------------------|------------|
| nonprovisional | NO           | \$1510        | \$300               | \$0                  | \$1810           | 12/07/2010 |

| EXAMINER            | ART UNIT | CLASS-SUBCLASS |
|---------------------|----------|----------------|
| PFIZENMAYER, MARK C | 2447     | 714-774000     |

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.  
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

- (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, 1 \_\_\_\_\_  
(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed. 2 \_\_\_\_\_  
3 \_\_\_\_\_

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

- ☐ Issue Fee  
☐ Publication Fee (No small entity discount permitted)  
☐ Advance Order - # of Copies \_\_\_\_\_

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)

- ☐ A check is enclosed.  
☐ Payment by credit card. Form PTO-2038 is attached.  
☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number \_\_\_\_\_ (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature \_\_\_\_\_ Date \_\_\_\_\_

Typed or printed name \_\_\_\_\_ Registration No. \_\_\_\_\_

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P. O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 11/246,163      | 10/11/2005  | Marcos C. Tzannes    | 5550-54             | 5478             |

62574 7590 09/07/2010

Jason H. Vick  
Sheridan Ross, PC  
Suite # 1200  
1560 Broadway  
Denver, CO 80202

EXAMINER

PFIZENMAYER, MARK C

|          |              |
|----------|--------------|
| ART UNIT | PAPER NUMBER |
|----------|--------------|

2447

DATE MAILED: 09/07/2010

**Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)**

(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 828 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 828 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.



|                               |                        |                     |  |
|-------------------------------|------------------------|---------------------|--|
| <b>Notice of Allowability</b> | <b>Application No.</b> | <b>Applicant(s)</b> |  |
|                               | 11/246,163             | TZANNES ET AL.      |  |
|                               | <b>Examiner</b>        | <b>Art Unit</b>     |  |
|                               | MARK PFIZENMAYER       | 2447                |  |

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--**

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to a telephone communications with Jason Vick (Reg. No. 45,285) on August 2 and 3, 2010.

2. ☒ The allowed claim(s) is/are 46-53 (renumbered as claims 1-8).

3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
     a) ☐ All    b) ☐ Some\*    c) ☐ None    of the:  
         1. ☐ Certified copies of the priority documents have been received.  
         2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
         3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).  
     \* Certified copies not received: \_\_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.  
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS ( as "replacement sheets") must be submitted.  
     (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review ( PTO-948) attached  
         1) ☐ hereto or 2) ☐ to Paper No./Mail Date \_\_\_\_\_.  
     (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_\_.  
**Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

|                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)<br>2. <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948)<br>3. <input checked="" type="checkbox"/> Information Disclosure Statements (PTO/SB/08),<br>Paper No./Mail Date <u>12/22/09 and 8/9/10</u><br>4. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit<br>of Biological Material | 5. <input type="checkbox"/> Notice of Informal Patent Application<br>6. <input type="checkbox"/> Interview Summary (PTO-413),<br>Paper No./Mail Date _____.<br>7. <input checked="" type="checkbox"/> Examiner's Amendment/Comment<br>8. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance<br>9. <input type="checkbox"/> Other _____. |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**DETAILED ACTION**

1. The applicant cancelled claims 1-45, and added claims 46-29 in the amendment filed on 12/17/2009. The applicant amended claim 46 and added claims 50-53 in the supplemental amendment filed on 12/30/2009. The applicant amended claims 46 and 50 in the supplemental amendment filed on 3/8/2010. Claims 46-53 are pending.

**EXAMINER'S AMENDMENT**

2. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

3. Authorization for this examiner's amendment was given in a telephone interviews with Jason Vick (Reg. No. 45,285) on August 2 and 3, 2010.

4. The application has been amended as follows:

- Replace claim 46 with:

46. A method of allocating shared memory in a transceiver comprising:  
transmitting or receiving, by the transceiver, a message during initialization specifying a maximum number of bytes of memory that are available to be allocated to an interleaver;  
determining, at the transceiver, an amount of memory required by the interleaver to interleave a first plurality of Reed Solomon (RS) coded data bytes within a shared memory;  
allocating, in the transceiver, a first number of bytes of the shared memory to the interleaver to interleave the first plurality of Reed Solomon (RS) coded data bytes for

transmission at a first data rate, wherein the allocated memory for the interleaver does not exceed the maximum number of bytes specified in the message;

allocating, in the transceiver, a second number of bytes of the shared memory to a deinterleaver to deinterleave a second plurality of RS coded data bytes received at a second data rate; and

interleaving the first plurality of RS coded data bytes within the shared memory allocated to the interleaver and deinterleaving the second plurality of RS coded data bytes within the shared memory allocated to the deinterleaver, wherein the shared memory allocated to the interleaver is used at the same time as the shared memory allocated to the deinterleaver.

- Replace claim 47 with:

47. The method of claim 46, wherein the determining is based on an impulse noise protection requirement.

- Replace claim 48 with:

48. The method of claim 46, wherein the determining is based on a latency requirement.

- Replace claim 49 with:

49. The method of claim 46, wherein the determining is based on a bit error rate requirement.

- Replace claim 50 with:

50. A method of allocating shared memory in a transceiver comprising:  
transmitting or receiving, by the transceiver, a message during initialization specifying a maximum number of bytes of memory that are available to be allocated to a deinterleaver;

determining, at the transceiver, an amount of memory required by the deinterleaver to deinterleave a first plurality of Reed Solomon (RS) coded data bytes within a shared memory;

allocating, in the transceiver, a first number of bytes of the shared memory to the deinterleaver to deinterleave a first plurality of Reed Solomon (RS) coded data bytes for transmission at a first data rate, wherein the allocated memory for the deinterleaver does not exceed the maximum number of bytes specified in the message;

allocating, in the transceiver, a second number of bytes of the shared memory to an interleaver to interleave a second plurality of RS coded data bytes received at a second data rate; and

deinterleaving the first plurality of RS coded data bytes within the shared memory allocated to the deinterleaver and interleaving the second plurality of RS coded data bytes within the shared memory allocated to the interleaver, wherein the shared memory allocated to the deinterleaver is used at the same time as the shared memory allocated to the interleaver.

- Replace claim 51 with:

51. The method of claim 50, wherein the determining is based on an impulse noise protection requirement.

- Replace claim 52 with:

52. The method of claim 50, wherein the determining is based on a latency requirement.

- Replace claim 53 with:

53. The method of claim 50, wherein the determining is based on a bit error rate requirement.

*Allowable Subject Matter*

5. Claims 46-53 are allowed.

Claim 46 identifies the distinct features of specifying a maximum number of bytes available to be allocated to an interleaver in a transmitted or received message, determining the amount of memory required by the interleaver, and then allocating the bytes of a shared memory to the interleaver wherein the bytes allocated do not exceed the maximum number of available bytes specified in the message.

The closest prior art, Fadavi-Ardekani et al (U.S. Pat. No. 6,707,822) discloses sharing a memory between the interleavers and deinterleavers of multiple ADSL sessions, fails to suggest limiting the memory allocated to the interleaver to a maximum number of bytes available that was specified in a transmitted or received message. The above features in conjunction with all other limitations of the dependent and independent claims 46-49 are hereby allowed.

Claim 50 identifies the distinct features of specifying a maximum number of bytes available to be allocated to a deinterleaver in a transmitted or received message, determining the amount of memory required by the deinterleaver, and then allocating the bytes of a shared memory to the deinterleaver wherein the bytes allocated do not exceed the maximum number of available bytes specified in the message.

The closest prior art, Fadavi-Ardekani et al (U.S. Pat. No. 6,707,822) discloses sharing a memory between the interleavers and deinterleavers of multiple ADSL sessions, fails to suggest limiting the memory allocated to the deinterleaver to a maximum number of bytes available that was specified in a transmitted or received message. The above features in conjunction with all other limitations of the dependent and independent claims 50-53 are hereby allowed.

*Conclusion*

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to MARK PFIZENMAYER whose telephone number is (571)270-7214. The examiner can normally be reached on Monday - Friday 8:00 - 5:30 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, James Hwang can be reached on (571)272-4036. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Mark Pfizenmayer  
Patent Examiner  
3 August 2010

/Joon H. Hwang/  
Supervisory Patent Examiner, Art Unit 2447

|                                   |                                       |                                                              |             |
|-----------------------------------|---------------------------------------|--------------------------------------------------------------|-------------|
| <b>Notice of References Cited</b> | Application/Control No.<br>11/246,163 | Applicant(s)/Patent Under<br>Reexamination<br>TZANNES ET AL. |             |
|                                   | Examiner<br>MARK PFIZENMAYER          | Art Unit<br>2447                                             | Page 1 of 1 |

**U.S. PATENT DOCUMENTS**

| * |   | Document Number<br>Country Code-Number-Kind Code | Date<br>MM-YYYY | Name                   | Classification |
|---|---|--------------------------------------------------|-----------------|------------------------|----------------|
| * | A | US-6,707,822                                     | 03-2004         | Fadavi-Ardekani et al. | 370/395.5      |
|   | B | US-                                              |                 |                        |                |
|   | C | US-                                              |                 |                        |                |
|   | D | US-                                              |                 |                        |                |
|   | E | US-                                              |                 |                        |                |
|   | F | US-                                              |                 |                        |                |
|   | G | US-                                              |                 |                        |                |
|   | H | US-                                              |                 |                        |                |
|   | I | US-                                              |                 |                        |                |
|   | J | US-                                              |                 |                        |                |
|   | K | US-                                              |                 |                        |                |
|   | L | US-                                              |                 |                        |                |
|   | M | US-                                              |                 |                        |                |

**FOREIGN PATENT DOCUMENTS**

| * |   | Document Number<br>Country Code-Number-Kind Code | Date<br>MM-YYYY | Country | Name | Classification |
|---|---|--------------------------------------------------|-----------------|---------|------|----------------|
|   | N |                                                  |                 |         |      |                |
|   | O |                                                  |                 |         |      |                |
|   | P |                                                  |                 |         |      |                |
|   | Q |                                                  |                 |         |      |                |
|   | R |                                                  |                 |         |      |                |
|   | S |                                                  |                 |         |      |                |
|   | T |                                                  |                 |         |      |                |

**NON-PATENT DOCUMENTS**

| * |   | Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages) |
|---|---|-------------------------------------------------------------------------------------------|
|   | U |                                                                                           |
|   | V |                                                                                           |
|   | W |                                                                                           |
|   | X |                                                                                           |

\*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)  
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

|                                                                                                             |                                            |                                                                  |
|-------------------------------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------------------------------------|
| <b>Index of Claims</b><br> | <b>Application/Control No.</b><br>11246163 | <b>Applicant(s)/Patent Under Reexamination</b><br>TZANNES ET AL. |
|                                                                                                             | <b>Examiner</b><br>Mark Pfizenmayer        | <b>Art Unit</b><br>2447                                          |

|   |                 |   |                   |   |                     |   |                 |
|---|-----------------|---|-------------------|---|---------------------|---|-----------------|
| ✓ | <b>Rejected</b> | - | <b>Cancelled</b>  | N | <b>Non-Elected</b>  | A | <b>Appeal</b>   |
| = | <b>Allowed</b>  | ÷ | <b>Restricted</b> | I | <b>Interference</b> | O | <b>Objected</b> |

| <input type="checkbox"/> Claims renumbered in the same order as presented by applicant |          |            |            |            | <input type="checkbox"/> CPA |  | <input type="checkbox"/> T.D. |  | <input type="checkbox"/> R.1.47 |  |
|----------------------------------------------------------------------------------------|----------|------------|------------|------------|------------------------------|--|-------------------------------|--|---------------------------------|--|
| CLAIM                                                                                  |          | DATE       |            |            |                              |  |                               |  |                                 |  |
| Final                                                                                  | Original | 12/29/2008 | 12/01/2009 | 08/03/2010 |                              |  |                               |  |                                 |  |
|                                                                                        | 1        | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 2        | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 3        | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 4        | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 5        | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 6        | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 7        | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 8        | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 9        | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 10       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 11       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 12       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 13       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 14       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 15       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 16       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 17       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 18       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 19       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 20       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 21       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 22       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 23       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 24       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 25       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 26       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 27       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 28       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 29       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 30       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 31       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 32       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 33       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 34       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 35       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 36       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |



|                                                                                                                    |                                            |                                                                  |
|--------------------------------------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------------------------------------|
| <b><i>Index of Claims</i></b><br> | <b>Application/Control No.</b><br>11246163 | <b>Applicant(s)/Patent Under Reexamination</b><br>TZANNES ET AL. |
|                                                                                                                    | <b>Examiner</b><br>Mark Pfizenmayer        | <b>Art Unit</b><br>2447                                          |

|   |                 |   |                   |   |                     |   |                 |
|---|-----------------|---|-------------------|---|---------------------|---|-----------------|
| ✓ | <b>Rejected</b> | - | <b>Cancelled</b>  | N | <b>Non-Elected</b>  | A | <b>Appeal</b>   |
| = | <b>Allowed</b>  | ÷ | <b>Restricted</b> | I | <b>Interference</b> | O | <b>Objected</b> |

| <input type="checkbox"/> Claims renumbered in the same order as presented by applicant |          |            |            |            | <input type="checkbox"/> CPA |  | <input type="checkbox"/> T.D. |  | <input type="checkbox"/> R.1.47 |  |
|----------------------------------------------------------------------------------------|----------|------------|------------|------------|------------------------------|--|-------------------------------|--|---------------------------------|--|
| CLAIM                                                                                  |          | DATE       |            |            |                              |  |                               |  |                                 |  |
| Final                                                                                  | Original | 12/29/2008 | 12/01/2009 | 08/03/2010 |                              |  |                               |  |                                 |  |
|                                                                                        | 37       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 38       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 39       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 40       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 41       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 42       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 43       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 44       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
|                                                                                        | 45       | ✓          | ✓          | -          |                              |  |                               |  |                                 |  |
| 1                                                                                      | 46       |            |            | =          |                              |  |                               |  |                                 |  |
| 2                                                                                      | 47       |            |            | =          |                              |  |                               |  |                                 |  |
| 3                                                                                      | 48       |            |            | =          |                              |  |                               |  |                                 |  |
| 4                                                                                      | 49       |            |            | =          |                              |  |                               |  |                                 |  |
| 5                                                                                      | 50       |            |            | =          |                              |  |                               |  |                                 |  |
| 6                                                                                      | 51       |            |            | =          |                              |  |                               |  |                                 |  |
| 7                                                                                      | 52       |            |            | =          |                              |  |                               |  |                                 |  |
| 8                                                                                      | 53       |            |            | =          |                              |  |                               |  |                                 |  |



## SEARCH RESULTS

You searched for: maximum memory available to interleaver

Results per Page:

Showing 1 - 25 of 9,597 results

**Quantum Memory Hierarchies: Efficient Designs to Match Available Parallelism in Quantum Computing**

Thaker, D.D.; Metodi, T.S.; Cross, A.W.; Chuang, I.L.; Cheng, F.T.;

Computer Architecture, 2006. ISCA '06. 33rd International Symposium on

Digital Object Identifier: 10.1109/ISCA.2006.32

Publication Year: 2006 , Page(s): 378 - 390

IEEE CONFERENCES

**High performance, high throughput turbo/ SOVA decoder design**

Zhongfeng Wang; Parhi, K.K.;

Communications, IEEE Transactions on

Volume: 51 , Issue: 4

Digital Object Identifier: 10.1109/TCOMM.2003.810832

Publication Year: 2003 , Page(s): 570 - 579

IEEE JOURNALS

**ReCPU: A parallel and pipelined architecture for regular expression matching**

Paolieri, Marco; Bonesana, Ivano; Santambrogio, Marco D.;

Very Large Scale Integration, 2007. VLSI - SoC 2007. IHP

International Conference on

Digital Object Identifier: 10.1109/VLSISOC.2007.4402466

Publication Year: 2007 , Page(s): 19 - 24

IEEE CONFERENCES

**Multiple templates access of trees in parallel memory systems**

Auletta, V.; De Vivo, A.; Scarano, V.;

Parallel Processing Symposium, 1997. Proceedings., 11th International

Digital Object Identifier: 10.1109/PPS.1997.580980

Publication Year: 1997 , Page(s): 694 - 701

IEEE CONFERENCES

**Development of a Hard Microcontroller**

Measel, P. R.; Sivo, L. L.; Quilitz, W. E.; Davidson, T. K.;

Nuclear Science, IEEE Transactions on

Volume: 23 , Issue: 6

Digital Object Identifier: 10.1109/TNS.1976.4328571

Publication Year: 1976 , Page(s): 1738 - 1742

IEEE JOURNALS

**Studying Asynchronous Shared Memory Computations**

Juvaste, S.;

Parallel Architecture and Compilation Techniques, 2007. FACT

2007. 16th International Conference on

Digital Object Identifier: 10.1109/PACT.2007.4336241

Publication Year: 2007 , Page(s): 413 - 413

IEEE CONFERENCES

Receipt date: 12/22/2009

11246163 - GAU: 2447

|                                                          |   |    |   |                          |                     |
|----------------------------------------------------------|---|----|---|--------------------------|---------------------|
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b> |   |    |   | <b>Complete if Known</b> |                     |
|                                                          |   |    |   | Application Number       | 11/246,163          |
|                                                          |   |    |   | Filing Date              | October 11, 2005    |
|                                                          |   |    |   | First Named Inventor     | LUND, MICHAEL       |
|                                                          |   |    |   | Art Unit                 | 2447                |
|                                                          |   |    |   | Examiner Name            | Mark C. Pfizenmayer |
| Sheet                                                    | 1 | of | 1 | Attorney Docket Number   | 5550-54             |

| U.S. PATENT DOCUMENTS |                          |                                                             |                                |                                                    |                                                                                 |
|-----------------------|--------------------------|-------------------------------------------------------------|--------------------------------|----------------------------------------------------|---------------------------------------------------------------------------------|
| Examiner<br>Initials* | Cite<br>No. <sup>1</sup> | Document Number<br>Number-kind Code <sup>2</sup> (if known) | Publication Date<br>MM-DD-YYYY | Name of Patentee of<br>Applicant of Cited Document | Pages, Columns, Lines, Where<br>Relevant Passages or Relevant<br>Figures Appear |

| FOREIGN PATENT DOCUMENTS |                          |                                                                                                                   |                                   |                                                    |                                                                                          |                |
|--------------------------|--------------------------|-------------------------------------------------------------------------------------------------------------------|-----------------------------------|----------------------------------------------------|------------------------------------------------------------------------------------------|----------------|
| Examiner<br>Initials*    | Cite<br>No. <sup>1</sup> | Foreign Patent Document<br>Country Code <sup>3</sup> ; Number <sup>4</sup> ; Kind<br>Code <sup>5</sup> (if known) | Publication<br>Date<br>MM-DD-YYYY | Name of Patentee or<br>Applicant of Cited Document | Pages, Columns,<br>Lines, Where<br>Relevant<br>Passages or<br>Relevant Figures<br>Appear | T <sup>6</sup> |

| OTHER ART (Including Author, Title, Date, Pertinent Pages, etc.) |                          |                                                                                                                                                                              |
|------------------------------------------------------------------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Examiner<br>Initials*                                            | Cite<br>No. <sup>1</sup> |                                                                                                                                                                              |
|                                                                  | 1                        | Notification of the First Office Action (including translation) for Chinese Patent Application No. 200580032703, mailed September 25, 2009 (Attorney's Ref. No. 5550-54-PCN) |

|                       |                    |                    |            |
|-----------------------|--------------------|--------------------|------------|
| Examiner<br>Signature | /Mark Pfizenmayer/ | Date<br>Considered | 07/15/2010 |
|-----------------------|--------------------|--------------------|------------|

\*EXAMINER: Initial if reference is considered, whether or not citation is in conformance and not considered. Include copy of this form with next communication to applicant.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /M.P./

Web Images Videos Maps News Shopping Gmail more

X

My Account | Sign out

Google scholar

maximum memory available to interleaver

Search

Advanced Scholar Search  
Scholar Preferences

Scholar

Articles and patents

anytime

include citations

Create email alert

Results 1 - 10 of about 71,500. (0.24 sec)

[CITATION] On maximum contention-free interleavers and permutation polynomials over integer rings  
OY Takeshita - IEEE Transactions on Information Theory, 2006  
Cited by 46 - Related articles - All Direct - All 12 versions

arxiv.org [PDF]

[PDF] The Cydra 5 stride-insensitive memory system  
BR Rau, MS Schlansker, DWL Yen - Proc Int Conf on Parallel ..., 1989 - Citeseer  
... When the request rate approaches the maximum bandwidth that the memory system is designed for, the randomness of ... In the Cydra 5, 8-, 16- and 32-way interleaving are available in addition to the full 64 ... Also, the presence of four memory banks is similar to 4-way interleaving. ...  
Cited by 66 - Related articles - All 3 versions

psu.edu [PDF]

[PDF] A NUMA API for Linux  
A Kleen - Novel Inc, 2005 - andikleen.de  
... The program can allocate node memory somewhere between the free memory (which is normally low because Linux uses free memory for caches) and the maximum memory size. This function gives a hint for how much memory is available for allocation on each node, but it ...  
Cited by 25 - Related articles - View as HTML - All 5 versions

andikleen.de [PDF]

... determining sizes of 1: 1 and 2: 1 memory interleaving in a computer system, configuring to the maximum size, and informing the user if memory is incorrectly installed  
LG Hobson - US Patent 5,809,555, 1999 - Google Patents  
... 1 AND 2:1 MEMORY INTERLEAVING IN A COMPUTER SYSTEM, CONFIGURING TO THE MAXIMUM SIZE, AND ... result in the loss of some memory in a system configured for 2:1 interleaving. ... may not yield optimal perfor- mance if the total amount of available memory is thereby ...  
Cited by 8 - Related articles

[PDF] High-performance programmable SISO decoder VLSI implementation for decoding turbo codes  
... T Yokokawa, M Kan, Y Mizutani, ... - GLOBECOM ..., 2001 - gladstone.systems.cs.cit.edu  
... Some of them have already been available on products [6], [7]. However, in order to ... chip interleavers/deinterleavers (maximum 16K) • capable of 1-3 symbol-wise interleave • arbitrary interleaver patterns • adapt ... Maximum memory lengths of the codes are different for each type. ...  
Cited by 24 - Related articles - View as HTML - All 5 versions

cs.cit.edu [PDF]

Method for interleaving computer disk data input-out transfers with permuted buffer addressing  
TJ Parks - US Patent 5,404,454, 1995 - Google Patents  
... Data from the disk drives may be simultaneously loaded into two different memory buffers utilizing the maximum available I/O ... 5,404,454 METHOD FOR INTERLEAVING COMPUTER DISK DATA INPUT-OUT TRANSFERS WITH PERMUTED BUFFER ADDRESSING ...  
Cited by 11 - Related articles

Memory bank customization and assignment in behavioral synthesis  
PR Panda - Proceedings of the 1999 IEEE/ACM international ..., 1999 - portal.acm.org  
... Memory packing tech- niques for realizing the required memory for an application in terms of available components were ... Note that there is no simple way to interleave ai and c 2i. ... can also be used to solve a vari- ant of the problem stated as: given a maximum memory size 478 ...  
Cited by 45 - Related articles - All Direct - All 3 versions

york.ac.uk [PDF]

Dynamic memory mapper which supports interleaving across 2, sup. N+ 1, 2, sup. N, sup. N-1 number of banks for reducing contention during nonunit stride accesses  
JH Mirza, SW White - US Patent 5,247,645, 1993 - Google Patents  
... cessor cycle. Multiple ports or pipes in a vector design increase the interleave requirements. In ... memory. This 60 results in reducing the number of BSMs by a factor of two which, in turn, halves the available memory. An alternative ...  
Cited by 12 - Related articles

Low-power mapping of behavioral arrays to multiple memories  
P Panda, N Dutt - Proceedings of the 1996 international symposium ..., 1996 - portal.acm.org  
... tion is common in performance-critical systems where the required data access rate exceeds the maximum ac- cess ... 4). In Figure 2, logical array par- titions K1 and K3 are merged into logical memory L1. Finally, we map the logical memories into the available physical memories ...  
Cited by 18 - Related articles - All 2 versions

psu.edu [PDF]

[CITATION] A mixed QoS SDRAM controller for FPGA-based high-end image processing  
DIS Heinicke, DIA do Carmo Lucas  
Cited by 25 - Related articles - All 3 versions

psu.edu [PDF]

Create email alert

Result Page:

1 2 3 4 5 6 7 8 9 10

Next

Receipt date: 08/09/2010

11246163 - GAU: 2447

|                                                          |   |    |   |                          |                     |
|----------------------------------------------------------|---|----|---|--------------------------|---------------------|
| Substitute for form 1449A/PTO                            |   |    |   | <b>Complete if Known</b> |                     |
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b> |   |    |   | Application Number       | 11/246,163          |
|                                                          |   |    |   | Filing Date              | October 11, 2005    |
|                                                          |   |    |   | First Named Inventor     | LUND, MICHAEL       |
|                                                          |   |    |   | Art Unit                 | 2447                |
|                                                          |   |    |   | Examiner Name            | Mark C. Pfizenmayer |
| Sheet                                                    | 1 | of | 2 | Attorney Docket Number   | 5550-54             |

| U.S. PATENT DOCUMENTS |                       |                                                          |                             |                                                 |                                                                           |
|-----------------------|-----------------------|----------------------------------------------------------|-----------------------------|-------------------------------------------------|---------------------------------------------------------------------------|
| Examiner Initials*    | Cite No. <sup>1</sup> | Document Number Number-Kind Code <sup>2</sup> (if known) | Publication Date MM-DD-YYYY | Name of Patentee of Applicant of Cited Document | Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear |
|                       | 1                     | 2004/0114536                                             | 06/17/04                    | O'Rourke                                        |                                                                           |
|                       | 2                     | 2005/0180323                                             | 08/18/05                    | Beightol et al.                                 |                                                                           |
|                       | 3                     | 2003/0067877                                             | 04/10/03                    | Sivakumar et al.                                |                                                                           |
|                       | 4                     | 2009/0300450                                             | 12/03/09                    | Tzannes (10-02-2008)                            |                                                                           |
|                       | 5                     | 12/783758                                                |                             | Tzannes (05-20-2010)                            |                                                                           |
|                       | 6                     | 12/760728                                                |                             | Tzannes (04-15-2010)                            |                                                                           |
|                       | 7                     | 12/783765                                                |                             | Tzannes (05-20-2010)                            |                                                                           |
|                       | 8                     | 12/761586                                                |                             | Lund et al. (4/16/2010)                         |                                                                           |

| FOREIGN PATENT DOCUMENTS |                       |                                                                                                             |                             |                                                 |                                                                           |                |
|--------------------------|-----------------------|-------------------------------------------------------------------------------------------------------------|-----------------------------|-------------------------------------------------|---------------------------------------------------------------------------|----------------|
| Examiner Initials*       | Cite No. <sup>1</sup> | Foreign Patent Document Country Code <sup>3</sup> ; Number <sup>4</sup> ; Kind Code <sup>5</sup> (if known) | Publication Date MM-DD-YYYY | Name of Patentee or Applicant of Cited Document | Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear | T <sup>6</sup> |
|                          | 9                     | EP 1225735                                                                                                  | 07/24/02                    | Matsushita Electronic Ind Co Ltd                |                                                                           |                |
|                          | 10                    | EP 1246409                                                                                                  | 10/02/02                    | Mitsubishi Electric Corp                        |                                                                           |                |
|                          | 11                    | WO 2006/044227                                                                                              | 04/27/06                    | Aware Inc.                                      |                                                                           |                |

| OTHER ART (Including Author, Title, Date, Pertinent Pages, etc.) |                       |                                                                                                                                                                                                                    |                            |
|------------------------------------------------------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| Examiner Initials*                                               | Cite No. <sup>1</sup> |                                                                                                                                                                                                                    |                            |
|                                                                  | 12                    | Shoji, T. et al: "Wireless Access Method to Ensure Each Users QOS in Unpredictable and Various QOS Requirements Wireless Personal Communications," Springer, Dordrecht, NL, Vol. 22, No. 2, Aug. 2002, pp. 139-151 |                            |
|                                                                  | 13                    | "ITU-T Recommendation G.992.5 - Series G: Transmission Systems and Media, Digital Systems and Networks", International Telecommunication Union, ADSL2, May 2003, 92 pages                                          |                            |
| Examiner Signature                                               | /Mark Pfizenmayer/    |                                                                                                                                                                                                                    | Date Considered 08/30/2010 |

\*EXAMINER: Initial if reference is considered, whether or not citation is in conformance and not considered. Include copy of this form with next communication to applicant.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /M.P./

Receipt date: 08/09/2010

11246163 - GAU: 2447

|                                                          |   |    |   |                          |                     |
|----------------------------------------------------------|---|----|---|--------------------------|---------------------|
| Substitute for form 1449A/PTO                            |   |    |   | <b>Complete if Known</b> |                     |
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b> |   |    |   | Application Number       | 11/246,163          |
|                                                          |   |    |   | Filing Date              | October 11, 2005    |
|                                                          |   |    |   | First Named Inventor     | LUND, MICHAEL       |
|                                                          |   |    |   | Art Unit                 | 2447                |
|                                                          |   |    |   | Examiner Name            | Mark C. Pfizenmayer |
| Sheet                                                    | 2 | of | 2 | Attorney Docket Number   | 5550-54             |

|    |                                                                                                    |
|----|----------------------------------------------------------------------------------------------------|
| 14 | "ITU-T Recommendation G.992.3," International Telecommunication Union, ADSL2, Jan. 2005, 436 pages |
| 15 | "VDSL2 ITU-T Recommendation G.993.2," International Telecommunication Union, Feb. 2006, 252 pages  |

|                       |                    |                    |            |
|-----------------------|--------------------|--------------------|------------|
| Examiner<br>Signature | /Mark Pfizenmayer/ | Date<br>Considered | 08/30/2010 |
|-----------------------|--------------------|--------------------|------------|

\*EXAMINER: Initial if reference is considered, whether or not citation is in conformance and not considered. Include copy of this form with next communication to applicant.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /M.P./

File 347:JAPIO Dec 1976-2010/Apr(Updated 100726)  
(c) 2010 JPO & JAPIO  
File 350:Derwent WPIX 1963-2010/UD=201049  
(c) 2010 Thomson Reuters

? ds

| Set | Items  | Description                                                                                                                                                                                                                                                                                                              |
|-----|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S1  | 52734  | (MAX OR MAXIMUM OR CEILING OR LIMIT OR THRESHOLD OR BOUNDARY OR UPPERMOST OR TOPMOST) (5N) (MEMORY OR CAPACITY OR SPACE OR ROOM)                                                                                                                                                                                         |
| S2  | 288    | (MOST OR HIGHEST OR GREATEST OR LARGEST) (3W) (AMOUNT OR QUANTITY OR NUMBER OR VOLUME OR DENSITY) (3W) (BYTES OR BITS OR SPACE OR ROOM OR CAPACITY OR MEMORY)                                                                                                                                                            |
| S3  | 10280  | S1:S2(10N) (SEND??? OR SENT OR TRANSMIT? OR TRANSMISSION OR TRANSFER? OR COMMUNICAT? OR DELIVER? OR CONVEY? OR FORWARD? OR PROVIDE OR PROVIDES OR PROVIDED OR PROVIDING OR RELAY? OR RECEIV? OR RECEPTION OR UPLOAD? OR DOWNLOAD?)                                                                                       |
| S4  | 3613   | INTERLEAVER? ? OR DEINTERLEAVER? ? OR INTER()LEAVER? ? OR LATENCY(1W) (PATH? ? OR PATHWAY? ?)                                                                                                                                                                                                                            |
| S5  | 641    | S4(15N) (CONFIGUR? OR ALLOCAT? OR ASSIGN? OR RESERV? OR MODIF? OR MANIPULAT? OR ALTER? OR CHANG? OR INCREAS? OR DECREAS? OR LOWER? OR RAIS?)                                                                                                                                                                             |
| S6  | 3      | S3 AND S5                                                                                                                                                                                                                                                                                                                |
| S7  | 12     | S3 AND S4                                                                                                                                                                                                                                                                                                                |
| S8  | 9      | S7 NOT S6                                                                                                                                                                                                                                                                                                                |
| S9  | 3      | S8 AND PY=1963:2004                                                                                                                                                                                                                                                                                                      |
| S10 | 5      | S8 AND AY=1963:2004 AND AC=US                                                                                                                                                                                                                                                                                            |
| S11 | 6      | S9:S10                                                                                                                                                                                                                                                                                                                   |
| S12 | 1      | PN=US 20060088054                                                                                                                                                                                                                                                                                                        |
| S13 | 0      | S12 AND S3                                                                                                                                                                                                                                                                                                               |
| S14 | 7786   | (MAX OR MAXIMUM OR CEILING OR LIMIT OR THRESHOLD OR BOUNDARY OR UPPERMOST OR TOPMOST) (5N)DEPTH                                                                                                                                                                                                                          |
| S15 | 4      | (MOST OR HIGHEST OR GREATEST OR LARGEST) (3W) (AMOUNT OR QUANTITY OR NUMBER OR VOLUME OR DENSITY) (3W)DEPTH                                                                                                                                                                                                              |
| S16 | 5      | S14:S15 AND S4                                                                                                                                                                                                                                                                                                           |
| S17 | 4      | S16 NOT S7                                                                                                                                                                                                                                                                                                               |
| S18 | 723988 | TRANSCIEIVER? ? OR RECEIVER? ? OR TRANSMITTER? ?                                                                                                                                                                                                                                                                         |
| S19 | 339    | S1:S2(7N)S18(7N) (SEND??? OR SENT OR TRANSMIT? ? OR TRANSMITTED OR TRANSMITTING OR TRANSMISSION OR TRANSFER? OR COMMUNICAT? OR DELIVER? OR CONVEY? OR FORWARD? OR PROVIDE OR PROVIDES OR PROVIDED OR PROVIDING OR RELAY? OR RECEIV? OR RECEPTION OR UPLOAD? OR DOWNLOAD?)                                                |
| S20 | 17     | (S1:S2 OR S14:S15) (10N)ADVERTIS???                                                                                                                                                                                                                                                                                      |
| S21 | 1      | S20 AND (S4 OR S18)                                                                                                                                                                                                                                                                                                      |
| S22 | 68677  | (TRANSCIEIVER? ? OR RECEIVER(N)TRANSMITTER) (5N) (SEND??? OR SENT OR TRANSMIT? ? OR TRANSMITTED OR TRANSMITTING OR TRANSMISSION OR TRANSFER? OR COMMUNICAT? OR DELIVER? OR CONVEY? OR FORWARD? OR PROVIDE OR PROVIDES OR PROVIDED OR PROVIDING OR RELAY? OR RECEIV? OR RECEPTION OR UPLOAD? OR DOWNLOAD? OR ADVERTIS???) |
| S23 | 32     | S22(10N)S1:S2                                                                                                                                                                                                                                                                                                            |

|     |    |                                                 |
|-----|----|-------------------------------------------------|
| S24 | 32 | S23 NOT (S7 OR S17)                             |
| S25 | 25 | S24 AND PY=1963:2004                            |
| S26 | 20 | S24 AND AY=1963:2004 AND AC=US                  |
| S27 | 28 | S25:S26                                         |
| S28 | 28 | IDPAT (sorted in duplicate/non-duplicate order) |



File 347:JAPIO Dec 1976-2010/Apr(Updated 100726)  
(c) 2010 JPO & JAPIO  
File 350:Derwent WPIX 1963-2010/UD=201050  
(c) 2010 Thomson Reuters

? ds

| Set | Items | Description                                                                                                                                                                                                                                                                        |
|-----|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S1  | 60381 | (MAX OR MAXIMUM OR CEILING OR LIMIT OR THRESHOLD OR BOUNDARY OR UPPERMOST OR TOPMOST) (5N) (MEMORY OR CAPACITY OR SPACE OR ROOM OR DEPTH)                                                                                                                                          |
| S2  | 290   | (MOST OR HIGHEST OR GREATEST OR LARGEST) (3W) (AMOUNT OR QUANTITY OR NUMBER OR VOLUME OR DENSITY) (3W) (BYTES OR BITS OR SPACE OR ROOM OR CAPACITY OR MEMORY OR DEPTH)                                                                                                             |
| S3  | 10970 | S1:S2(10N) (SEND??? OR SENT OR TRANSMIT? ? OR TRANSMITTED OR TRANSMITTING OR TRANSMISSION OR TRANSFER? OR COMMUNICAT? OR DELIVER? OR CONVEY? OR FORWARD? OR PROVIDE OR PROVIDES OR PROVIDED OR PROVIDING OR RELAY? OR RECEIV? OR RECEPTION OR UPLOAD? OR DOWNLOAD? OR ADVERTIS???) |
| S4  | 56808 | (DATA OR COMMUNICATION OR TRANSMISSION) (1W) (PATH? ? OR PATHWAY? ?) OR FCI()BLOCK                                                                                                                                                                                                 |
| S5  | 9357  | S4(15N) (CONFIGUR? OR ALLOCAT? OR ASSIGN? OR RESERV? OR MODIF? OR MANIPULAT? OR ALTER? OR CHANG? OR INCREAS? OR DECREAS? OR LOWER? OR RAIS?)                                                                                                                                       |
| S6  | 27    | S3 AND S5                                                                                                                                                                                                                                                                          |
| S7  | 15    | S6 AND PY=1963:2004                                                                                                                                                                                                                                                                |
| S8  | 15    | S6 AND AY=1963:2004 AND AC=US                                                                                                                                                                                                                                                      |
| S9  | 17    | S7:S8                                                                                                                                                                                                                                                                              |
| S10 | 17    | IDPAT (sorted in duplicate/non-duplicate order)                                                                                                                                                                                                                                    |

File 348:EUROPEAN PATENTS 1978-201030  
(c) 2010 European Patent Office  
File 349:PCT FULLTEXT 1979-2010/UB=20100805|UT=20100729  
(c) 2010 WIPO/Thomson

? ds

| Set | Items  | Description                                                                                                                                                                                                                                                                                                                                     |
|-----|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S1  | 67716  | (MAX OR MAXIMUM OR CEILING OR LIMIT OR THRESHOLD OR BOUNDARY OR UPPERMOST OR TOPMOST) (5N) (MEMORY OR CAPACITY OR SPACE OR ROOM OR DEPTH)                                                                                                                                                                                                       |
| S2  | 894    | (MOST OR HIGHEST OR GREATEST OR LARGEST) (3W) (AMOUNT OR QUANTITY OR NUMBER OR VOLUME OR DENSITY) (3W) (BYTES OR BITS OR SPACE OR ROOM OR CAPACITY OR MEMORY OR DEPTH)                                                                                                                                                                          |
| S3  | 11551  | S1:S2(10N) (SEND??? OR SENT OR TRANSMIT? ? OR TRANSMITTED OR TRANSMITTING OR TRANSMISSION OR TRANSFER? OR COMMUNICAT? OR DELIVER? OR CONVEY? OR FORWARD? OR PROVIDE OR PROVIDES OR PROVIDED OR PROVIDING OR RELAY? OR RECEIV? OR RECEPTION OR UPLOAD? OR DOWNLOAD? OR ADVERTIS???)                                                              |
| S4  | 64674  | INTERLEAVER? ? OR DEINTERLEAVER? ? OR INTER()LEAVER? ? OR (LATENCY OR DATA OR COMMUNICATION OR TRANSMISSION) (1W) (PATH? ? OR PATHWAY? ?) OR FCI()BLOCK                                                                                                                                                                                         |
| S5  | 13802  | S4(15N) (CONFIGUR? OR ALLOCAT? OR ASSIGN? OR RESERV? OR MODIF? OR MANIPULAT? OR ALTER??? OR ALTERATION? ? OR CHANG? OR INCREAS? OR DECREAS? OR LOWER? OR RAIS?)                                                                                                                                                                                 |
| S6  | 20     | S3(100N)S5                                                                                                                                                                                                                                                                                                                                      |
| S7  | 9      | S6 AND PY=1978:2004                                                                                                                                                                                                                                                                                                                             |
| S8  | 8      | S6 AND (AC=US OR AC=US/PR) AND AY=1978:2004                                                                                                                                                                                                                                                                                                     |
| S9  | 13     | S7:S8                                                                                                                                                                                                                                                                                                                                           |
| S10 | 13     | IDPAT (sorted in duplicate/non-duplicate order)                                                                                                                                                                                                                                                                                                 |
| S11 | 109    | S1:S2(10N)BROADCAST???                                                                                                                                                                                                                                                                                                                          |
| S12 | 0      | S11(100N)S5                                                                                                                                                                                                                                                                                                                                     |
| S13 | 286670 | (TRANSCIEVER? ? OR RECEIVER? ? OR TRANSMITTER? ?) (5N) (SEND??? OR SENT OR TRANSMIT? ? OR TRANSMITTED OR TRANSMITTING OR TRANSMISSION OR TRANSFER? OR COMMUNICAT? OR DELIVER? OR CONVEY? OR FORWARD? OR PROVIDE OR PROVIDES OR PROVIDED OR PROVIDING OR RELAY? OR RECEIV? OR RECEPTION OR UPLOAD? OR DOWNLOAD? OR ADVERTIS??? OR BROADCAST???)  |
| S14 | 479    | S13(10N)S1:S2                                                                                                                                                                                                                                                                                                                                   |
| S15 | 90455  | (TRANSCIEVER? ? OR RECEIVER? ? (1N)TRANSMITTER? ?) (5N) (SEND??? OR SENT OR TRANSMIT? ? OR TRANSMITTED OR TRANSMITTING OR TRANSMISSION OR TRANSFER? OR COMMUNICAT? OR DELIVER? OR CONVEY? OR FORWARD? OR PROVIDE OR PROVIDES OR PROVIDED OR PROVIDING OR RELAY? OR RECEIV? OR RECEPTION OR UPLOAD? OR DOWNLOAD? OR ADVERTIS??? OR BROADCAST???) |
| S16 | 84     | S15(10N)S1:S2                                                                                                                                                                                                                                                                                                                                   |
| S17 | 83     | S16 NOT S6                                                                                                                                                                                                                                                                                                                                      |
| S18 | 42     | S17 AND PY=1978:2004                                                                                                                                                                                                                                                                                                                            |
| S19 | 33     | S17 AND (AC=US OR AC=US/PR) AND AY=1978:2004                                                                                                                                                                                                                                                                                                    |
| S20 | 47     | S18:S19                                                                                                                                                                                                                                                                                                                                         |
| S21 | 47     | IDPAT (sorted in duplicate/non-duplicate order)                                                                                                                                                                                                                                                                                                 |
| S22 | 419    | (MAXIMUM OR MOST OR HIGHEST OR GREATEST OR LARGEST) (3W) (AMOUNT OR QUANTITY OR DENSITY) (3W) (STORAGE() (SPACE OR ROOM OR CAPACITY) OR MEMORY OR RAM)                                                                                                                                                                                          |

S23            53    S22(7N)(SEND??? OR SENT OR TRANSMIT? ? OR TRANSMITTED OR TRANSMITTING OR  
TRANSMISSION OR TRANSFER? OR COMMUNICAT? OR DELIVER? OR CONVEY? OR FORWARD? OR PROVIDE  
OR PROVIDES OR PROVIDED OR PROVIDING OR RELAY? OR RECEIV? OR RECEPTION OR UPLOAD? OR  
DOWNLOAD? OR ADVERTIS??? OR BROADCAST???)

S24            40    S23 AND PY=1978:2004

S25            23    S23 AND (AC=US OR AC=US/PR) AND AY=1978:2004

S26            41    S24:S25

S27            41    IDPAT (sorted in duplicate/non-duplicate order)

File 347:JAPIO Dec 1976-2010/Apr(Updated 100726)  
(c) 2010 JPO & JAPIO  
File 350:Derwent WPIX 1963-2010/UD=201050  
(c) 2010 Thomson Reuters

.....  
? ds

| Set | Items | Description                                                                                                                                                                                                                        |
|-----|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S1  | 143   | (MAXIMUM OR MOST OR HIGHEST OR GREATEST OR LARGEST) (3W) (AMOUNT OR QUANTITY OR DENSITY) (3W) (STORAGE) (SPACE OR ROOM OR CAPACITY) OR MEMORY OR RAM)                                                                              |
| S2  | 11    | S1(10N) (SEND??? OR SENT OR TRANSMIT? ? OR TRANSMITTED OR TRANSMITTING OR TRANSMISSION OR TRANSFER? OR COMMUNICAT? OR DELIVER? OR CONVEY? OR FORWARD? OR RELAY? OR RECEIV? OR RECEPTION OR UPLOAD? OR ADVERTIS??? OR BROADCAST???) |
| S3  | 24    | S1(30N) (SEND??? OR SENT OR TRANSMIT? ? OR TRANSMITTED OR TRANSMITTING OR TRANSMISSION OR TRANSFER? OR COMMUNICAT? OR DELIVER? OR CONVEY? OR FORWARD? OR RELAY? OR RECEIV? OR RECEPTION OR UPLOAD? OR ADVERTIS??? OR BROADCAST???) |
| S4  | 13    | S3 NOT S2                                                                                                                                                                                                                          |

File 8: Ei Compendex(R) 1884-2010/Aug W1  
(c) 2010 Elsevier Eng. Info. Inc.  
File 35: Dissertation Abs Online 1861-2010/Jun  
(c) 2010 ProQuest Info&Learning  
File 65: Inside Conferences 1993-2010/Aug 10  
(c) 2010 BLDSC all rts. reserv.  
File 2: INSPEC 1898-2010/Aug W1  
(c) 2010 The IET  
File 6: NTIS 1964-2010/Aug W2  
(c) 2010 NTIS, Intl Cpyrght All Rights Res  
File 144: Pascal 1973-2010/Aug W1  
(c) 2010 INIST/CNRS  
File 434: SciSearch(R) Cited Ref Sci 1974-1989/Dec  
(c) 2006 The Thomson Corp  
File 34: SciSearch(R) Cited Ref Sci 1990-2010/Aug W1  
(c) 2010 The Thomson Corp  
File 99: Wilson Appl. Sci & Tech Abs 1983-2010/May  
(c) 2010 The HW Wilson Co.  
File 266: FEDRIP 2010/Jun  
Comp & dist by NTIS, Intl Copyright All Rights Res  
File 95: TEME-Technology & Management 1989-2010/Jul W1  
(c) 2010 FIZ TECHNIK  
File 56: Computer and Information Systems Abstracts 1966-2010/May  
(c) 2010 CSA.  
File 60: ANTE: Abstracts in New Tech & Engineer 1966-2010/May  
(c) 2010 CSA.

---

? ds

| Set | Items  | Description                                                                                                                                                                                                                                                                                        |
|-----|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S1  | 142746 | (MAX OR MAXIMUM OR CEILING OR LIMIT OR THRESHOLD OR BOUNDARY OR UPPERMOST OR TOPMOST) (5N) (MEMORY OR RAM OR CAPACITY OR SPACE OR ROOM OR DEPTH)                                                                                                                                                   |
| S2  | 302    | (MOST OR HIGHEST OR GREATEST OR LARGEST) (3W) (AMOUNT OR QUANTITY OR NUMBER OR VOLUME OR DENSITY) (3W) (BYTES OR BITS OR SPACE OR ROOM OR CAPACITY OR MEMORY OR RAM OR DEPTH)                                                                                                                      |
| S3  | 9025   | S1:S2(10N) (SEND??? OR SENT OR TRANSMIT? ? OR TRANSMITTED OR TRANSMITTING OR TRANSMISSION OR TRANSFER? OR COMMUNICAT? OR DELIVER? OR CONVEY? OR FORWARD? OR PROVIDE OR PROVIDES OR PROVIDED OR PROVIDING OR RELAY? OR RECEIV? OR RECEPTION OR UPLOAD? OR DOWNLOAD? OR ADVERTIS??? OR BROADCAST???) |
| S4  | 92870  | INTERLEAVER? ? OR DEINTERLEAVER? ? OR INTER()LEAVER? ? OR (LATENCY OR DATA OR COMMUNICATION OR TRANSMISSION) (1W) (PATH? ? OR PATHWAY? ?) OR FCI()BLOCK                                                                                                                                            |
| S5  | 4839   | S4(15N) (CONFIGUR? OR ALLOCAT? OR ASSIGN? OR RESERV? OR MODIF? OR MANIPULAT? OR ALTER??? OR ALTERATION? ? OR CHANG? OR INCREAS? OR DECREAS? OR LOWER? OR RAIS?)                                                                                                                                    |
| S6  | 12     | S3 AND S5                                                                                                                                                                                                                                                                                          |
| S7  | 9      | RD (unique items)                                                                                                                                                                                                                                                                                  |
| S8  | 127    | S3 AND S4                                                                                                                                                                                                                                                                                          |

S9            6596    S1:S2(10N) (SEND??? OR SENT OR TRANSMIT? ? OR TRANSMITTED OR TRANSMITTING  
                  OR TRANSMISSION OR TRANSFER? OR COMMUNICAT? OR DELIVER? OR CONVEY? OR FORWARD? OR RELAY?  
                  OR RECEIV? OR RECEPTION OR UPLOAD? OR DOWNLOAD? OR ADVERTIS??? OR BROADCAST???)

S10           118    S9 AND S4  
 S11           107    RD   (unique items)  
 S12           51    S11 NOT PY=2005:2010  
 S13           49    S12 NOT S7  
 S14           67877   (TRANSCIVER? ? OR RECEIVER? ?(1N)TRANSMITTER? ?)(5N) (SEND??? OR SENT OR  
                  TRANSMIT? ? OR TRANSMITTED OR TRANSMITTING OR TRANSMISSION OR TRANSFER? OR COMMUNICAT?  
                  OR DELIVER? OR CONVEY? OR FORWARD? OR PROVIDE OR PROVIDES OR PROVIDED OR PROVIDING OR  
                  RELAY? OR RECEIV? OR RECEPTION OR UPLOAD? OR DOWNLOAD? OR ADVERTIS??? OR BROADCAST???)

S15           31    S14(7N)S1:S2  
 S16           30    RD   (unique items)  
 S17           19    S16 NOT (S13 OR S7 OR PY=2005:2010)  
 S18           56    (MAXIMUM OR MOST OR HIGHEST OR GREATEST OR LARGEST) (3W) (AMOUNT OR  
                  QUANTITY OR DENSITY) (3W) (STORAGE() (SPACE OR ROOM OR CAPACITY) OR MEMORY OR RAM)

S19           4    S18(30N) (SEND??? OR SENT OR TRANSMIT? ? OR TRANSMITTED OR TRANSMITTING OR  
                  TRANSMISSION OR TRANSFER? OR COMMUNICAT? OR DELIVER? OR CONVEY? OR FORWARD? OR RELAY? OR  
                  RECEIV? OR RECEPTION OR UPLOAD? OR ADVERTIS??? OR BROADCAST???)

S20           4    RD   (unique items)



USPTO

[Subscribe \(Full Service\)](#) [Register \(Limited Service, Free\)](#) [Login](#)

Search: ◆ The ACM Digital Library ○ The Guide

maximum memory available to interleaver

Searching within **The ACM Digital Library** for: maximum memory available to interleaver ([start a new search](#))

Found 31 of 285,344

**REFINE YOUR SEARCH**

▼ Refine by Keywords

maximum memory av:

Discovered Terms

▼ Refine by People

Names  
Institutions  
Authors  
Reviewers

▼ Refine by Publications

Publication Year  
Publication Names  
ACM Publications  
All Publications  
Publishers

▼ Refine by Conferences

Sponsors  
Events  
Proceeding Series

Search Results    Related Journals    Related SIGs    Related Conferences

Results 1 - 20 of 31

[Save results to a Binder](#)

Sort by relevance in expanded form

Result page: 1   2   next   >>

- 1 [InfiniteReality: a real-time graphics system](#)

[John S. Montrym](#), [Daniel B. Baum](#), [David L. Dugan](#), [Christopher J. Migdal](#)

August 1997 **SIGGRAPH '97: Proceedings of the 24th annual conference on Computer graphics and interactive techniques**

**Publisher:** ACM Press/Addison-Wesley Publishing Co. [Request Permissions](#)

Full text available: [PDF](#) (1.00 MB)    Additional Information: [full citation](#), [references](#), [cited by](#), [index terms](#)

**Bibliometrics:** Downloads (6 Weeks): 13, Downloads (12 Months): 129, Downloads (Overall): 1122, Citation Count: 60
- 2 [An uplink CDMA system architecture with diverse QoS guarantees for heterogeneous traffic](#)

[Sunghyun Choi](#), [Kang G. Shin](#)

October 1999 **IEEE/ACM Transactions on Networking (TON)** . Volume 7 Issue 5

**Publisher:** IEEE Press

Full text available: [PDF](#) (408.20 KB)    Additional Information: [full citation](#), [references](#), [cited by](#), [index terms](#)

**Bibliometrics:** Downloads (6 Weeks): 2, Downloads (12 Months): 40, Downloads (Overall): 501, Citation Count: 12

**Keywords:** CDMA systems, QoS guarantees, admission control, automatic retransmission reQuest, multicode CDMA, power control, reed-Solomon/convolutional concatenated code, transmission-rate request access protocol, wireless/mobile communication
- 3 [Hierarchical coarse-grained stream compilation for software defined radio](#)

[Yuan Lin](#), [Manjunath Kudihur](#), [Soni Mahika](#), [Ilavar Mudan](#)

September 2007 **CASES '07: Proceedings of the 2007 international conference on Compilers, architecture, and synthesis for embedded systems**

**Publisher:** ACM

Full text available: [PDF](#) (464.76 KB)    Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

**Bibliometrics:** Downloads (6 Weeks): 11, Downloads (12 Months): 56, Downloads (Overall): 225, Citation Count: 1

Software Defined Radio (SDR) is an emerging embedded domain where the physical layer of wireless protocols is implemented in software rather than the traditional application specific hardware. The operation throughput requirements of current third-generation ...

**Keywords:** MPSoC compilation, dataflow programming model, modulo scheduling, software defined radio
- 4 [COTSon: infrastructure for full system simulation](#)

[Eduardo Argello](#), [Ayosa Falcon](#), [Paolo Faraboschi](#), [Matteo Monchiero](#), [Daniel Ortega](#)

January 2009 **SIGOPS Operating Systems Review** . Volume 43 Issue 1

**Publisher:** ACM

Full text available: [PDF](#) (836.87 KB)    Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

**Bibliometrics:** Downloads (6 Weeks): 40, Downloads (12 Months): 277, Downloads (Overall): 362, Citation Count: 3

Simulation has historically been the primary technique used for evaluating the performance of new proposals in computer architecture. Speed and complexity considerations have traditionally limited its applicability to single-thread processors running ...

**Keywords:** full system simulation
- 5 [Adaptive rate controlled, robust video communication over packet wireless networks](#)

[S. R. Rajagopal](#), [B. H. M. Hateg](#)

June 1998 **Mobile Networks and Applications** . Volume 3 Issue 1

**Publisher:** Kluwer Academic Publishers

Full text available: [PDF](#) (977.91 KB)    Additional Information: [full citation](#), [abstract](#), [references](#), [cited by](#), [index terms](#), [review](#)

**Bibliometrics:** Downloads (6 Weeks): 0, Downloads (12 Months): 26, Downloads (Overall): 497, Citation Count: 2

Video transmission over wireless packet networks is gaining importance due to the concept of universal personal communication. Further, it is considered an important step towards wireless multimedia. The challenge however is to achieve good video quality ...

6



## UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
 United States Patent and Trademark Office  
 Address: COMMISSIONER FOR PATENTS  
 P.O. Box 1450  
 Alexandria, Virginia 22313-1450  
 www.uspto.gov

## BIB DATA SHEET

CONFIRMATION NO. 5478

|                                                                                                                                                                                                                                                                                                  |                                                                                                                   |                                                          |                                                                                                                                                                                                                                                                           |                                       |                           |                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|---------------------------|--------------------------------|
| <b>SERIAL NUMBER</b><br>11/246,163                                                                                                                                                                                                                                                               | <b>FILING or 371(c) DATE</b><br>10/11/2005<br><b>RULE</b>                                                         | <b>CLASS</b><br>711<br>714                               | <b>GROUP ART UNIT</b><br>2447                                                                                                                                                                                                                                             | <b>ATTORNEY DOCKET NO.</b><br>5550-54 |                           |                                |
| <b>APPLICANTS</b><br>Marcos C. Tzannes, Orinda, CA;<br>Michael Lund, West Newton, MA;<br><b>** CONTINUING DATA *****</b><br>This appln claims benefit of 60/618,269 10/12/2004<br><b>** FOREIGN APPLICATIONS *****</b><br><b>** IF REQUIRED, FOREIGN FILING LICENSE GRANTED **</b><br>11/07/2005 |                                                                                                                   |                                                          |                                                                                                                                                                                                                                                                           |                                       |                           |                                |
| Foreign Priority claimed <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No<br>35 USC 119(a-d) conditions met <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No<br>Verified and Acknowledged <u>/Mark Pfizenmayer/</u><br>Examiner's Signature                |                                                                                                                   | <input type="checkbox"/> Met after Allowance<br>Initials | <b>STATE OR COUNTRY</b><br>CA                                                                                                                                                                                                                                             | <b>SHEETS DRAWINGS</b><br>3           | <b>TOTAL CLAIMS</b><br>45 | <b>INDEPENDENT CLAIMS</b><br>5 |
| <b>ADDRESS</b><br>Jason H. Vick<br>Sheridan Ross, PC<br>Suite # 1200<br>1560 Broadway<br>Denver, CO 80202<br>UNITED STATES                                                                                                                                                                       |                                                                                                                   |                                                          |                                                                                                                                                                                                                                                                           |                                       |                           |                                |
| <b>TITLE</b><br>Resource sharing in a telecommunications environment                                                                                                                                                                                                                             |                                                                                                                   |                                                          |                                                                                                                                                                                                                                                                           |                                       |                           |                                |
| <b>FILING FEE RECEIVED</b><br>2780                                                                                                                                                                                                                                                               | FEES: Authority has been given in Paper<br>No. _____ to charge/credit DEPOSIT ACCOUNT<br>No. _____ for following: |                                                          | <input type="checkbox"/> All Fees<br><input type="checkbox"/> 1.16 Fees (Filing)<br><input type="checkbox"/> 1.17 Fees (Processing Ext. of time)<br><input type="checkbox"/> 1.18 Fees (Issue)<br><input type="checkbox"/> Other _____<br><input type="checkbox"/> Credit |                                       |                           |                                |



## EAST Search History

## EAST Search History (Prior Art)

| Ref # | Hits   | Search Query                                                                                                                                       | DBs                                                   | Default Operator | Plurals | Time Stamp          |
|-------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|------------------|---------|---------------------|
| S283  | 769    | 379/93.01.ccls.                                                                                                                                    | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR               | ON      | 2010/07/27<br>18:45 |
| S284  | 3633   | 375/222.ccls.                                                                                                                                      | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR               | ON      | 2010/07/27<br>18:46 |
| S285  | 1149   | 714/774,784.ccls.                                                                                                                                  | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR               | ON      | 2010/07/27<br>18:46 |
| S286  | 161201 | "370"/\$.ccls.                                                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR               | ON      | 2010/07/27<br>18:46 |
| S287  | 17     | reed same shar\$5 near2 (memory<br>buffer) same interleav\$3                                                                                       | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR               | ON      | 2010/07/27<br>18:47 |
| S288  | 187639 | (max maximum limit\$5 cap\$4) same<br>(available free total remain\$4) same<br>(memory buffer byte)                                                | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR               | ON      | 2010/07/27<br>18:48 |
| S289  | 336    | S288 and interleav\$3 and reed and<br>shar\$5 near2 (memory buffer)                                                                                | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR               | ON      | 2010/07/27<br>18:49 |
| S290  | 2      | S289 and S284                                                                                                                                      | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR               | ON      | 2010/07/27<br>18:49 |
| S291  | 2252   | (max maximum limit\$5 cap\$4) same<br>(available free total remain\$4) same<br>(memory buffer byte) same (configur<br>\$6 set\$1up) same parameter | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR               | ON      | 2010/07/27<br>18:53 |
| S292  | 7      | S291 and S284                                                                                                                                      | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR               | ON      | 2010/07/27<br>18:54 |

|      |        |                                                                                                                                                                    |                                                       |    |    |                     |
|------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----|----|---------------------|
| S293 | 2      | S291 and S285                                                                                                                                                      | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/27<br>18:58 |
| S294 | 2688   | (max maximum limit\$5 cap\$4) same<br>(available free total remain\$4) same<br>(memory buffer byte) same (configur<br>\$6 set\$1up initializ\$6) same<br>parameter | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/27<br>19:03 |
| S295 | 0      | S291 and S284 not S292                                                                                                                                             | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/27<br>19:03 |
| S296 | 1      | S294 and S284 not S292                                                                                                                                             | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/27<br>19:03 |
| S297 | 769    | 379/93.01.ccls.                                                                                                                                                    | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>11:44 |
| S298 | 3633   | 375/222.ccls.                                                                                                                                                      | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>11:44 |
| S299 | 1149   | 714/774,784.ccls.                                                                                                                                                  | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>11:44 |
| S300 | 161201 | "370"/\$.ccls.                                                                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>11:44 |
| S301 | 5      | reed same shar\$5 same memory<br>same dsl                                                                                                                          | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>11:44 |
| S302 | 24800  | dsl same modem                                                                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>11:44 |
| S303 | 54     | S302 and reed and shar\$5 adj2<br>memory                                                                                                                           | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>11:45 |

|      |        |                                                                                                                   |                                                       |    |    |                     |
|------|--------|-------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----|----|---------------------|
| S304 | 50     | S302 and reed and shar\$5 adj2 memory and interleav\$3                                                            | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>11:45 |
| S305 | 7      | S304 and S298                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>11:46 |
| S306 | 476625 | (configur\$6 set\$1up set adj up intializ<br>\$6 allocat\$3) same (parameter setting<br>shar\$5 adj2 memory)      | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>12:12 |
| S307 | 733    | S306 and S298                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>12:12 |
| S308 | 49     | S306 and S303                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>12:12 |
| S309 | 1286   | (configur\$6 set\$1up set adj up intializ<br>\$6 allocat\$3) same (parameter<br>setting) same shar\$5 adj2 memory | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>12:12 |
| S310 | 12     | S309 and S303                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>12:13 |
| S311 | 4      | S309 and S298                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>12:13 |
| S312 | 477599 | (exchang\$3 transmit\$4 send\$3 trad<br>\$3) same (parameter setting)                                             | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>12:15 |
| S313 | 764    | S309 and S312                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>12:15 |
| S314 | 502    | interleav\$3 and reed and shar\$5 adj2<br>(memory buffer)                                                         | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>12:16 |

|      |        |                                                                                                                                                                                                                                   |                                                       |    |    |                     |
|------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----|----|---------------------|
| S315 | 15     | S313 and S314                                                                                                                                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>12:16 |
| S316 | 18572  | (exchang\$3 transmit\$4 send\$3 trad\$3<br>configur\$6 set\$1up set adj up intializ<br>\$6 allocat\$3) same (parameter<br>setting) same (available free remain<br>\$3 max maximum total) near6<br>(memory space buffer byte size) | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>12:19 |
| S317 | 60     | S316 and S298                                                                                                                                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>12:19 |
| S318 | 5      | S317 and S314                                                                                                                                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>12:19 |
| S319 | 55     | S317 not S318                                                                                                                                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>12:23 |
| S320 | 2862   | S316 and S300                                                                                                                                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>12:33 |
| S321 | 15     | S320 and S314                                                                                                                                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>12:33 |
| S322 | 769    | 379/93.01.ccls.                                                                                                                                                                                                                   | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>13:44 |
| S323 | 3633   | 375/222.ccls.                                                                                                                                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>13:44 |
| S324 | 1149   | 714/774,784.ccls.                                                                                                                                                                                                                 | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>13:44 |
| S325 | 161201 | "370"/\$.ccls.                                                                                                                                                                                                                    | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>13:44 |

|      |       |                                                                                                                                                                                                                    |                                                       |    |    |                     |
|------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----|----|---------------------|
| S326 | 18572 | (exchang\$3 transmit\$4 send\$3 trad\$3 configur\$6 set\$1up set adj up intializ \$6 allocat\$3) same (parameter setting) same (available free remain \$3 max maximum total) near6 (memory space buffer byte size) | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>13:44 |
| S327 | 502   | interleav\$3 and reed and shar\$5 adj2 (memory buffer)                                                                                                                                                             | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>13:45 |
| S328 | 149   | S326 and S327                                                                                                                                                                                                      | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>13:45 |
| S329 | 0     | S328 and S322                                                                                                                                                                                                      | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>13:45 |
| S330 | 5     | S328 and S323                                                                                                                                                                                                      | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>13:45 |
| S331 | 1     | S328 and S324                                                                                                                                                                                                      | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>13:46 |
| S332 | 15    | S328 and S325                                                                                                                                                                                                      | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>13:47 |
| S333 | 3870  | (exchang\$3 transmit\$4 send\$3 trad\$3) same (parameter setting) and (max maximum) same (available free remain\$3) same (memory space buffer byte size) and (modem \$2dsl)                                        | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>13:51 |
| S334 | 26    | S333 and S327                                                                                                                                                                                                      | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>13:52 |
| S335 | 1     | "5136371".pn.                                                                                                                                                                                                      | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>13:55 |
| S336 | 47    | S333 and S323                                                                                                                                                                                                      | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>14:25 |

|      |        |                                                                                                                                                                                   |                                                       |    |    |                     |
|------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----|----|---------------------|
| S337 | 240731 | (exchang\$3 transmit\$4 send\$3 trad\$3) same (parameter setting) and (max maximum) naer6 (available free remain\$3) near6 (memory space buffer byte size) and (modem \$2dsl)     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>14:27 |
| S338 | 387    | (exchang\$3 transmit\$4 send\$3 trad\$3) same (parameter setting) and (max maximum) near6 (available free remain\$3) near6 (memory space buffer byte size) and (modem \$2dsl)     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>14:27 |
| S339 | 5      | S338 and S323                                                                                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>14:27 |
| S340 | 0      | S338 and S322                                                                                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>14:28 |
| S341 | 0      | S338 and S324                                                                                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>14:28 |
| S342 | 86     | S338 and S325                                                                                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>14:28 |
| S343 | 28     | S342 and (interleav\$3 reed shar\$5 adj2 memory)                                                                                                                                  | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>14:29 |
| S344 | 352    | (exchang\$3 transmit\$4 send\$3 trad\$3) same (device receiver transceiver modem) near4 (parameter setting) same (available free remain\$3) near6 (memory space buffer byte size) | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>14:50 |
| S345 | 0      | S344 and S327                                                                                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>14:50 |
| S346 | 3      | S344 and S323                                                                                                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>14:51 |
| S347 | 214    | (limit\$3 cap\$4 restrict\$3) near8 (interleaver \$3coder de\$1coder (data latency) adj path) near8 (max maximum available free) near6 (space memory buffer byte)                 | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>14:53 |

|      |      |                                                                                                                                                                                             |                                                       |    |    |                     |
|------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----|----|---------------------|
| S348 | 12   | S347 and S327                                                                                                                                                                               | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>14:53 |
| S349 | 0    | S347 and S323                                                                                                                                                                               | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>14:54 |
| S350 | 1    | S347 and S324                                                                                                                                                                               | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>14:54 |
| S351 | 8    | S347 and S325                                                                                                                                                                               | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>14:54 |
| S352 | 3    | (limit\$3 cap\$4 restrict\$3) near8<br>(interleaver \$3coder de\$1coder (data<br>latency) adj path) near8 (max<br>maximum available free) near6<br>(space memory buffer byte) and<br>\$2dsl | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>14:55 |
| S353 | 13   | (configur\$6 set\$1up set adj up initializ<br>\$6) same interleav\$3 near2 depth<br>same (max maximum available free)<br>near6 (space memory buffer byte)                                   | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>14:58 |
| S354 | 7946 | 711/147,153,157,170,173.ccls.                                                                                                                                                               | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>15:02 |
| S355 | 1590 | 711/173.ccls.                                                                                                                                                                               | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>15:02 |
| S356 | 5    | S354 and S323                                                                                                                                                                               | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>15:35 |
| S357 | 7    | S354 and S327                                                                                                                                                                               | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>15:41 |
| S358 | 937  | S354 and "55"                                                                                                                                                                               | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>15:42 |

|      |      |                   |                                                       |    |    |                     |
|------|------|-------------------|-------------------------------------------------------|----|----|---------------------|
| S359 | 501  | S354 and S326     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>15:42 |
| S360 | 86   | S355 and S326     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>15:42 |
| S361 | 3    | S354 and S328     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>15:45 |
| S362 | 2    | S354 and S347     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>15:52 |
| S363 | 4    | S354 and S344     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>15:55 |
| S364 | 1178 | S354 and S337     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>15:56 |
| S365 | 5    | S354 and S338     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>15:56 |
| S366 | 224  | S355 and S337     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>15:57 |
| S367 | 32   | S354 and S333     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>15:58 |
| S368 | 5    | S354 and S324     | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>16:17 |
| S369 | 1    | "20050246508".pn. | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>16:18 |



|      |     |                                                                                                                                                                                                                                                                                  |                                                       |    |    |                     |
|------|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----|----|---------------------|
| S370 | 612 | 711/157.ccls.                                                                                                                                                                                                                                                                    | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>16:34 |
| S371 | 5   | S370 and S327                                                                                                                                                                                                                                                                    | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>16:35 |
| S372 | 73  | S370 and S337                                                                                                                                                                                                                                                                    | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>16:35 |
| S373 | 2   | S370 and S347                                                                                                                                                                                                                                                                    | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>16:36 |
| S374 | 9   | ("5293607"   "5652861"   "5809555"<br>"6070227").PN. OR ("6233662").<br>URPN.                                                                                                                                                                                                    | US-PGPUB;<br>USPAT;<br>USOCR                          | OR | ON | 2010/07/28<br>16:36 |
| S375 | 12  | ("20020126673"   "20030021338"  <br>"20030084212"   "20030147410"  <br>"4432051"   "5109522"   "5873127"  <br>"5950211"   "6286092"   "6681239"  <br>"6687767").PN. OR ("7110373").<br>URPN.                                                                                     | US-PGPUB;<br>USPAT;<br>USOCR                          | OR | ON | 2010/07/28<br>16:55 |
| S376 | 98  | (limit\$3 cap\$4 restrict\$3) near6<br>(interleaver) near6 (space memory<br>buffer size)                                                                                                                                                                                         | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>17:30 |
| S377 | 13  | S376 and S370                                                                                                                                                                                                                                                                    | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>17:30 |
| S378 | 1   | S376 and S323                                                                                                                                                                                                                                                                    | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>17:30 |
| S379 | 17  | ("20010050943"   "20040044942"  <br>"20050138524"   "20050220202"  <br>"20060062287"   "20060153285"  <br>"20080052609"   "20080065969"  <br>"20080219290"   "20080232444"  <br>"20080298444"   "4695673"  <br>"6067646"   "6218579"   "6742155"  <br>"6885696"   "6971057").PN. | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>17:35 |
| S380 | 19  | exceed\$3 same (maximum max)<br>same (interleaver) same (space<br>memory buffer size byte allocation)                                                                                                                                                                            | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>17:38 |

|      |      |                                                                                                                                        |                                                       |    |    |                     |
|------|------|----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----|----|---------------------|
| S381 | 1    | S380 and S324                                                                                                                          | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>17:38 |
| S382 | 0    | S380 and S323                                                                                                                          | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/28<br>17:38 |
| S383 | 1461 | (initializ\$6 configur\$6 set\$1 up set adj<br>up allocat\$6) same (block path<br>interleaver) same limited near2<br>(resource memory) | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:25 |
| S384 | 503  | interleav\$3 and reed and shar\$5 adj2<br>(memory buffer)                                                                              | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:26 |
| S385 | 4    | S383 and S384                                                                                                                          | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:26 |
| S386 | 3634 | 375/222.ccls.                                                                                                                          | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:26 |
| S387 | 10   | S383 and S386                                                                                                                          | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:26 |
| S388 | 612  | 711/157.ccls.                                                                                                                          | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:29 |
| S389 | 0    | S383 and S388                                                                                                                          | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:29 |
| S390 | 1150 | 714/774,784.ccls.                                                                                                                      | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:30 |
| S391 | 1    | S383 and S390                                                                                                                          | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:30 |

|      |        |                                                                                                                           |                                                       |    |    |                     |
|------|--------|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----|----|---------------------|
| S392 | 161385 | "370"/\$.cls.                                                                                                             | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:30 |
| S393 | 152    | S383 and S392                                                                                                             | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:30 |
| S394 | 5      | S393 and interleaver                                                                                                      | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:30 |
| S395 | 200    | S383 and (multiple plurality) near4<br>(application (data latency) adj path)                                              | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:31 |
| S396 | 15     | S395 and \$dsl                                                                                                            | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:31 |
| S397 | 40     | S395 and modem                                                                                                            | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:32 |
| S398 | 29     | S397 not S396                                                                                                             | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:32 |
| S399 | 14     | ("20020059425"   "5297262"  <br>"5553287"   "5875479"   "6016495"  <br>"6631478"   "6671699").PN. OR<br>("7139894").URPN. | US-PGPUB;<br>USPAT;<br>USOCR                          | OR | ON | 2010/07/29<br>14:36 |
| S400 | 36     | (resource memory) near6 (conflict<br>contention) same interleaver                                                         | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:45 |
| S401 | 0      | S400 and S384                                                                                                             | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:45 |
| S402 | 0      | S400 and S386                                                                                                             | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:45 |

|      |        |                                                                                               |                                                       |    |    |                     |
|------|--------|-----------------------------------------------------------------------------------------------|-------------------------------------------------------|----|----|---------------------|
| S403 | 1      | S400 and shar\$5 adj2 (memory buffer)                                                         | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:46 |
| S404 | 65     | (requir\$2 needed) near8 interleaver same memory same (max maximum available free)            | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:48 |
| S405 | 235    | "65" and S384                                                                                 | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:48 |
| S406 | 3      | S404 and S384                                                                                 | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/07/29<br>14:48 |
| S407 | 1      | "20050154954".pn.                                                                             | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/08/03<br>14:55 |
| S408 | 188014 | (max maximum limit\$5 cap\$4) same (available free total remain\$4) same (memory buffer byte) | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/08/03<br>15:11 |
| S409 | 92     | S408 and 709/215.ccls.                                                                        | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2010/08/03<br>15:11 |

**EAST Search History (I nterference)**

| Ref # | Hits | Search Query                                                                | DBs         | Default Operator | Plurals | Time Stamp       |
|-------|------|-----------------------------------------------------------------------------|-------------|------------------|---------|------------------|
| L1    | 179  | (maximum) same (memory bytes) same (interleaver deinterleaver)              | USPAT; UPAD | OR               | ON      | 2010/08/03 17:04 |
| L2    | 13   | (maximum) same (memory bytes) same (interleaver deinterleaver).clm.         | USPAT; UPAD | OR               | ON      | 2010/08/03 17:04 |
| L3    | 4    | (available free) near6 (memory bytes) same (interleaver deinterleaver).clm. | USPAT; UPAD | OR               | ON      | 2010/08/03 17:05 |

**8/ 3/ 2010 5:10:33 PM**
**C:\ Documents and Settings\ mpfizenmayer\ My Documents\ EAST\ Workspaces  
 \ 163\_Resource\_Share\_telecom\_part2.wsp**

|                                                                                                              |                                                |                                                                      |
|--------------------------------------------------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------|
| <b>Search Notes</b><br><br> | <b>Application/Control No.</b><br><br>11246163 | <b>Applicant(s)/Patent Under Reexamination</b><br><br>TZANNES ET AL. |
|                                                                                                              | <b>Examiner</b><br><br>Mark Pfizenmayer        | <b>Art Unit</b><br><br>2447                                          |

| SEARCHED |                     |           |          |
|----------|---------------------|-----------|----------|
| Class    | Subclass            | Date      | Examiner |
| 709      | 215                 | July 2010 | MCP      |
| 375      | 222                 | July 2010 | MCP      |
| 714      | 774,784             | July 2010 | MCP      |
| 711      | 147,153,157,170,173 | July 2010 | MCP      |
| 379      | 93.01               | July 2010 | MCP      |

| SEARCH NOTES                                                                           |           |          |
|----------------------------------------------------------------------------------------|-----------|----------|
| Search Notes                                                                           | Date      | Examiner |
| See search history printout                                                            | July 2010 | MCP      |
| 709/215; 379/93.01; 375/222; 714/774,784; 711/147,153,157,170,173; and 370 with text   | July 2010 | MCP      |
| Google/IEEE/ACM search                                                                 | July 2010 | MCP      |
| Consulted with Primary Bill Thomson regarding search, patentability and classification | July 2010 | MCP      |
| Consulted with Primaries Chaudry, Bonzo, and Torres regarding search classification    | July 2010 | MCP      |
| Consulted with Primary Dustin Nguyen regarding search                                  | July 2010 | MCP      |
| Inventor Name Search                                                                   | July 2010 | MCP      |
| STIC search                                                                            | July 2010 | MCP      |

| INTERFERENCE SEARCH |                                                           |          |          |
|---------------------|-----------------------------------------------------------|----------|----------|
| Class               | Subclass                                                  | Date     | Examiner |
|                     | USPAT and PGPUB text search – See search history printout | Aug 2010 | MCP      |

|  |  |
|--|--|
|  |  |
|--|--|

|                                                                                                                  |                                            |                                                                  |
|------------------------------------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------------------------------------|
| <b>Issue Classification</b><br> | <b>Application/Control No.</b><br>11246163 | <b>Applicant(s)/Patent Under Reexamination</b><br>TZANNES ET AL. |
|                                                                                                                  | <b>Examiner</b><br>MARK PFIZENMAYER        | <b>Art Unit</b><br>2447                                          |

| ORIGINAL           |                                   |  |          |  |  | INTERNATIONAL CLASSIFICATION |   |   |   |                  |             |  |  |  |  |  |  |  |
|--------------------|-----------------------------------|--|----------|--|--|------------------------------|---|---|---|------------------|-------------|--|--|--|--|--|--|--|
| CLASS              |                                   |  | SUBCLASS |  |  | CLAIMED                      |   |   |   |                  | NON-CLAIMED |  |  |  |  |  |  |  |
| 714                |                                   |  | 774      |  |  | H                            | 0 | 3 | M | 13 / 00 (2006.0) |             |  |  |  |  |  |  |  |
| CROSS REFERENCE(S) |                                   |  |          |  |  |                              |   |   |   |                  |             |  |  |  |  |  |  |  |
|                    |                                   |  |          |  |  |                              |   |   |   |                  |             |  |  |  |  |  |  |  |
| CLASS              | SUBCLASS (ONE SUBCLASS PER BLOCK) |  |          |  |  |                              |   |   |   |                  |             |  |  |  |  |  |  |  |
| 714                | 784                               |  |          |  |  |                              |   |   |   |                  |             |  |  |  |  |  |  |  |
| 375                | 222                               |  |          |  |  |                              |   |   |   |                  |             |  |  |  |  |  |  |  |
|                    |                                   |  |          |  |  |                              |   |   |   |                  |             |  |  |  |  |  |  |  |
|                    |                                   |  |          |  |  |                              |   |   |   |                  |             |  |  |  |  |  |  |  |
|                    |                                   |  |          |  |  |                              |   |   |   |                  |             |  |  |  |  |  |  |  |
|                    |                                   |  |          |  |  |                              |   |   |   |                  |             |  |  |  |  |  |  |  |
|                    |                                   |  |          |  |  |                              |   |   |   |                  |             |  |  |  |  |  |  |  |
|                    |                                   |  |          |  |  |                              |   |   |   |                  |             |  |  |  |  |  |  |  |
|                    |                                   |  |          |  |  |                              |   |   |   |                  |             |  |  |  |  |  |  |  |
|                    |                                   |  |          |  |  |                              |   |   |   |                  |             |  |  |  |  |  |  |  |
|                    |                                   |  |          |  |  |                              |   |   |   |                  |             |  |  |  |  |  |  |  |
|                    |                                   |  |          |  |  |                              |   |   |   |                  |             |  |  |  |  |  |  |  |
|                    |                                   |  |          |  |  |                              |   |   |   |                  |             |  |  |  |  |  |  |  |
|                    |                                   |  |          |  |  |                              |   |   |   |                  |             |  |  |  |  |  |  |  |

| <input type="checkbox"/> Claims renumbered in the same order as presented by applicant <input type="checkbox"/> CPA <input type="checkbox"/> T.D. <input type="checkbox"/> R.1.47 |          |       |          |       |          |       |          |       |          |       |          |       |          |       |          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------|----------|-------|----------|-------|----------|-------|----------|-------|----------|-------|----------|-------|----------|
| Final                                                                                                                                                                             | Original | Final | Original | Final | Original | Final | Original | Final | Original | Final | Original | Final | Original | Final | Original |
|                                                                                                                                                                                   | 1        |       | 17       |       | 33       | 4     | 49       |       |          |       |          |       |          |       |          |
|                                                                                                                                                                                   | 2        |       | 18       |       | 34       | 5     | 50       |       |          |       |          |       |          |       |          |
|                                                                                                                                                                                   | 3        |       | 19       |       | 35       | 6     | 51       |       |          |       |          |       |          |       |          |
|                                                                                                                                                                                   | 4        |       | 20       |       | 36       | 7     | 52       |       |          |       |          |       |          |       |          |
|                                                                                                                                                                                   | 5        |       | 21       |       | 37       | 8     | 53       |       |          |       |          |       |          |       |          |
|                                                                                                                                                                                   | 6        |       | 22       |       | 38       |       |          |       |          |       |          |       |          |       |          |
|                                                                                                                                                                                   | 7        |       | 23       |       | 39       |       |          |       |          |       |          |       |          |       |          |
|                                                                                                                                                                                   | 8        |       | 24       |       | 40       |       |          |       |          |       |          |       |          |       |          |
|                                                                                                                                                                                   | 9        |       | 25       |       | 41       |       |          |       |          |       |          |       |          |       |          |
|                                                                                                                                                                                   | 10       |       | 26       |       | 42       |       |          |       |          |       |          |       |          |       |          |
|                                                                                                                                                                                   | 11       |       | 27       |       | 43       |       |          |       |          |       |          |       |          |       |          |
|                                                                                                                                                                                   | 12       |       | 28       |       | 44       |       |          |       |          |       |          |       |          |       |          |
|                                                                                                                                                                                   | 13       |       | 29       |       | 45       |       |          |       |          |       |          |       |          |       |          |
|                                                                                                                                                                                   | 14       |       | 30       | 1     | 46       |       |          |       |          |       |          |       |          |       |          |
|                                                                                                                                                                                   | 15       |       | 31       | 2     | 47       |       |          |       |          |       |          |       |          |       |          |
|                                                                                                                                                                                   | 16       |       | 32       | 3     | 48       |       |          |       |          |       |          |       |          |       |          |

|                                                                                       |                      |                                   |                        |
|---------------------------------------------------------------------------------------|----------------------|-----------------------------------|------------------------|
| /MARK PFIZENMAYER/<br>Examiner.Art Unit 2447<br><br>(Assistant Examiner)              | 8/3/10<br>(Date)     | <b>Total Claims Allowed:</b><br>8 |                        |
| /Joon H Hwang/<br>Supervisory Patent Examiner.Art Unit 2447<br><br>(Primary Examiner) | 08/30/2010<br>(Date) | O.G. Print Claim(s)<br>1          | O.G. Print Figure<br>1 |

|                                                          |   |    |   |                          |                     |
|----------------------------------------------------------|---|----|---|--------------------------|---------------------|
| Substitute for form 1449A/PTO                            |   |    |   | <b>Complete if Known</b> |                     |
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b> |   |    |   | Application Number       | 11/246,163          |
|                                                          |   |    |   | Filing Date              | October 11, 2005    |
|                                                          |   |    |   | First Named Inventor     | LUND, MICHAEL       |
|                                                          |   |    |   | Art Unit                 | 2447                |
|                                                          |   |    |   | Examiner Name            | Mark C. Pfizenmayer |
| Sheet                                                    | 1 | of | 2 | Attorney Docket Number   | 5550-54             |

| U.S. PATENT DOCUMENTS |                       |                                                          |                             |                                                 |                                                                           |
|-----------------------|-----------------------|----------------------------------------------------------|-----------------------------|-------------------------------------------------|---------------------------------------------------------------------------|
| Examiner Initials*    | Cite No. <sup>1</sup> | Document Number Number-kind Code <sup>2</sup> (if known) | Publication Date MM-DD-YYYY | Name of Patentee or Applicant of Cited Document | Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear |
|                       | 1                     | 2004/0114536                                             | 06/17/04                    | O'Rourke                                        |                                                                           |
|                       | 2                     | 2005/0180323                                             | 08/18/05                    | Beightol et al.                                 |                                                                           |
|                       | 3                     | 2003/0067877                                             | 04/10/03                    | Sivakumar et al.                                |                                                                           |
|                       | 4                     | 2009/0300450                                             | 12/03/09                    | Tzannes (10-02-2008)                            |                                                                           |
|                       | 5                     | 12/783758                                                |                             | Tzannes (05-20-2010)                            |                                                                           |
|                       | 6                     | 12/760728                                                |                             | Tzannes (04-15-2010)                            |                                                                           |
|                       | 7                     | 12/783765                                                |                             | Tzannes (05-20-2010)                            |                                                                           |
|                       | 8                     | 12/761586                                                |                             | Lund et al. (4/16/2010)                         |                                                                           |

| FOREIGN PATENT DOCUMENTS |                       |                                                                                                             |                             |                                                 |                                                                           |                |
|--------------------------|-----------------------|-------------------------------------------------------------------------------------------------------------|-----------------------------|-------------------------------------------------|---------------------------------------------------------------------------|----------------|
| Examiner Initials*       | Cite No. <sup>1</sup> | Foreign Patent Document Country Code <sup>3</sup> ; Number <sup>4</sup> ; Kind Code <sup>5</sup> (if known) | Publication Date MM-DD-YYYY | Name of Patentee or Applicant of Cited Document | Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear | T <sup>6</sup> |
|                          | 9                     | EP 1225735                                                                                                  | 07/24/02                    | Matsushita Electronic Ind Co Ltd                |                                                                           |                |
|                          | 10                    | EP 1246409                                                                                                  | 10/02/02                    | Mitsubishi Electric Corp                        |                                                                           |                |
|                          | 11                    | WO 2006/044227                                                                                              | 04/27/06                    | Aware Inc.                                      |                                                                           |                |

| OTHER ART (Including Author, Title, Date, Pertinent Pages, etc.) |                       |                                                                                                                                                                                                                    |                 |
|------------------------------------------------------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Examiner Initials*                                               | Cite No. <sup>1</sup> |                                                                                                                                                                                                                    |                 |
|                                                                  | 12                    | Shoji, T. et al: "Wireless Access Method to Ensure Each Users QOS in Unpredictable and Various QOS Requirements Wireless Personal Communications," Springer, Dordrecht, NL, Vol. 22, No. 2, Aug. 2002, pp. 139-151 |                 |
|                                                                  | 13                    | "ITU-T Recommendation G.992.5 - Series G: Transmission Systems and Media, Digital Systems and Networks", International Telecommunication Union, ADSL2, May 2003, 92 pages                                          |                 |
| Examiner Signature                                               |                       |                                                                                                                                                                                                                    | Date Considered |

\*EXAMINER: Initial if reference is considered, whether or not citation is in conformance and not considered. Include copy of this form with next communication to applicant.

|                                                          |   |    |   |                          |                     |
|----------------------------------------------------------|---|----|---|--------------------------|---------------------|
| Substitute for form 1449A/PTO                            |   |    |   | <b>Complete if Known</b> |                     |
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b> |   |    |   | Application Number       | 11/246,163          |
|                                                          |   |    |   | Filing Date              | October 11, 2005    |
|                                                          |   |    |   | First Named Inventor     | LUND, MICHAEL       |
|                                                          |   |    |   | Art Unit                 | 2447                |
|                                                          |   |    |   | Examiner Name            | Mark C. Pfizenmayer |
| Sheet                                                    | 2 | of | 2 | Attorney Docket Number   | 5550-54             |

|  |    |                                                                                                    |
|--|----|----------------------------------------------------------------------------------------------------|
|  | 14 | "ITU-T Recommendation G.992.3," International Telecommunication Union, ADSL2, Jan. 2005, 436 pages |
|  | 15 | "VDSL2 ITU-T Recommendation G.993.2," International Telecommunication Union, Feb. 2006, 252 pages  |

|                       |  |                    |  |
|-----------------------|--|--------------------|--|
| Examiner<br>Signature |  | Date<br>Considered |  |
|-----------------------|--|--------------------|--|

\*EXAMINER: Initial if reference is considered, whether or not citation is in conformance and not considered. Include copy of this form with next communication to applicant.





(11) **EP 1 225 735 A1**

(12) **EUROPEAN PATENT APPLICATION**  
published in accordance with Art. 158(3) EPC

(43) Date of publication:  
**24.07.2002 Bulletin 2002/30**

(51) Int Cl.7: **H04L 12/56, H04L 29/08,  
H04L 1/16**

(21) Application number: **01947838.7**

(86) International application number:  
**PCT/JP01/05831**

(22) Date of filing: **05.07.2001**

(87) International publication number:  
**WO 02/05496 (17.01.2002 Gazette 2002/03)**

(84) Designated Contracting States:  
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE TR**  
Designated Extension States:  
**AL LT LV MK RO SI**

(30) Priority: **07.07.2000 JP 2000207296**  
**29.06.2001 JP 2001199621**

(71) Applicant: **MATSUSHITA ELECTRIC INDUSTRIAL  
CO., LTD.**  
**Kadoma-shi, Osaka 571-8501 (JP)**

(72) Inventors:  
• **IDO, Daiji**  
**Yokohama-shi, Kanagawa 236-0005 (JP)**  
• **IMURA, Koji**  
**Machida-shi, Tokyo 194-0013 (JP)**  
• **MIYAZAKI, Akihiro**  
**Sakai-shi, Osaka 591-8032 (JP)**  
• **HATA, Koichi**  
**Katano-shi, Osaka 576-0021 (JP)**

(74) Representative: **Grünecker, Kinkeldey,  
Stockmair & Schwanhäusser Anwaltssozietät**  
**Maximilianstrasse 58**  
**80538 München (DE)**

(54) **DATA COMMUNICATION SYSTEM**

(57) A data communication system capable of eliminating the retransmission of useless data that is too late for the playback time at the receiving side, and, accordingly, capable of eliminating the wasteful utilization of transmission band. In the system, round-trip time RTT

of a packet between the server (data transmitting apparatus) 100 and the terminal apparatus (data receiving apparatus) 200 is calculated, and only when the sum of the round-trip time RTT and present time is less than the playback time of the packet, retransmission request for lost packet which has high priority is made.

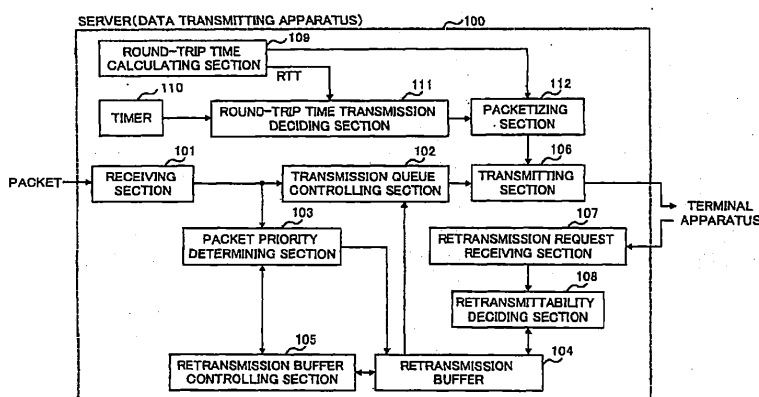


FIG.1

**Description****Technical Field**

**[0001]** The present invention relates to a data communication system, and to a data transmitting apparatus and a data receiving apparatus constituting the data communication system.

**Background Art**

**[0002]** Conventionally, when digital data (multimedia data) such as video or audio is transmitted via packet communication channel, as a transport-layer protocol, communication is carried out using TCP (Transmission Control Protocol) protocol which provides high reliability but does not take playback time of video or audio into consideration, or UDP (User Datagram Protocol) protocol which is suitable to real time communication but has a possibility that lost data may occur.

**[0003]** In a multimedia data communication utilizing TCP, such a processing is required in which data is played back after all of the data have been received by providing a memory for the receiving side. While in the case of utilizing UDP, since important data may be lost during the data playback, the quality of video or audio may be deteriorated.

**[0004]** Therefore, according to the Japanese Patent No. 2000-151680 A, when a data transmitted utilizing the UDP protocol is lost, a reliable transmission is realized by retransmission of the lost data utilizing the TCP protocol with high reliability.

**[0005]** The method of data transmission according to the Japanese Patent No. 2000-151680 A is described below. First of all, a receiving side receives a packet from a transmitting side and disassembles the packet, or detects that a packet has failed to be received. Sequence numbers are given to the packets, and these numbers are checked whenever receiving packets, and at a time when discontinuity of sequence numbers is detected, existence of packets which have failed to be received can be detected, or the number of packets which have failed to be received can be counted. Then, by transmitting loss information of the lost data indicating that the packet has failed to be received to the transmitting side, a retransmission request for the packet is made to the transmitting side. The transmitting side retransmits the packet requested to retransmit utilizing the TCP protocol with high reliability. Further, the receiving side is provided with a TCP packet disassembling section and a UDP packet disassembling section, and it is adapted so that any of the TCP packet and the UDP packet is disassembled and transferred to an RTP (Real-time Transfer Protocol) packet disassembling section.

**[0006]** However, in the conventional art, there is a problem that sometimes wasteful or useless data may be retransmitted during the transmission of a video or

audio data, since the transmitting side carries out the retransmission even when it is too late for the playback time, so that a wasteful transmission band is uselessly utilized as equal amount as that for transmission of the wasteful data. Due to the fact that the transmission band is used wastefully, then it becomes difficult to increase the capacity of the entire system since excess electric power for transmitting the wasteful data is required.

**Disclosure of the Invention**

**[0007]** It is an object of the present invention to provide a data communication system capable of eliminating the retransmission of useless data that is too late for the playback time at the receiving side, and, accordingly, capable of eliminating the wasteful utilization of transmission band.

**[0008]** According to an aspect of the present invention, a data communication system comprises a data transmitting apparatus and a data receiving apparatus, wherein the data transmitting apparatus comprises storing means for storing a retransmittable data only, retransmitting means for retransmitting a data that is extracted from the data stored in the storing means corresponding to a retransmission request of the data receiving apparatus, calculating means for calculating a data round-trip time between the data receiving apparatus and the data transmitting apparatus, and transmitting means for transmitting the data round-trip time calculated by the calculating means to the data receiving apparatus at a predetermined time interval, and wherein the data receiving apparatus comprises receiving means for receiving the data transmitted from the data transmitting apparatus, loss detecting means for detecting loss of data when the data is received by the receiving means, playback time calculating means for calculating playback time of the data received by the receiving means, round-trip time receiving means for receiving the data round-trip time transmitted from the transmitting means, and retransmission request deciding means for deciding, when a lost data is detected by the loss detecting means, whether a retransmission request for the lost data is made or not based on the playback time calculated by the playback time calculating means and the data round-trip time received by the round-trip time receiving means.

**[0009]** According to another aspect of the present invention, a data communication system comprising a data transmitting apparatus and a data receiving apparatus, wherein the data transmitting apparatus comprises storing means for storing a retransmittable data only, retransmitting means for retransmitting a data that is extracted from the data stored in the storing means corresponding to a retransmission request of the data receiving apparatus, measuring means for measuring a differential time between reception time of a first data transmitted from the data receiving apparatus and transmission time of a second data to be transmitted to the data

receiving apparatus in response to the first data, and transmitting means for transmitting the differential time measured by the measuring means included in the second data to the data receiving apparatus at a predetermined time interval, and wherein the data receiving apparatus comprises calculating means for calculating a data round-trip time between the data transmitting apparatus and the data receiving apparatus by subtracting transmission time of the first data transmitted to the data transmitting apparatus and the differential time included in the second data transmitted from the data transmitting apparatus from reception time of the second data, receiving means for receiving the data transmitted from the data transmitting apparatus, loss detecting means for detecting loss of data when the data is received by the receiving means, playback time calculating means for calculating playback time of the data received by the receiving means, and retransmission request deciding means for deciding, when a lost data is detected by the loss detecting means, whether a retransmission request for the lost data is made or not based on the playback time calculated by the playback time calculating means and the data round-trip time calculated by the calculating means.

#### Brief Description of the Drawings

#### [0010]

FIG. 1 is a block diagram showing a constitution of a data transmitting apparatus for a data communication system according to a first embodiment of the invention;

FIG. 2 is a block diagram showing a constitution of a data receiving apparatus for the data communication system according to the first embodiment of the invention;

FIG. 3 is a flowchart illustrating the contents of a round-trip time RTT transmitting processing in a server corresponding to the first embodiment;

FIG. 4 is a block diagram illustrating a constitution of a round-trip time calculating section of the server corresponding to the first embodiment;

FIG. 5 is a sequence diagram illustrating a calculating method of the round-trip time RTT in the server corresponding to the first embodiment;

FIG. 6 is a schematic illustration showing an example of a packet in which the round-trip time RTT is recorded and which is transmitted from the server corresponding to the first embodiment to a terminal apparatus;

FIG. 7 is a schematic illustration showing another example of a packet in which the round-trip time RTT is recorded and which is transmitted from the server corresponding to the first embodiment to the terminal apparatus;

FIG. 8 is a schematic illustration showing an example of a packet in which a differential time DLSR is

recorded and which is transmitted from the terminal to the server apparatus corresponding to the first embodiment of the invention;

FIG. 9 is a flowchart illustrating the contents of a differential time DLSR transmitting processing in the terminal apparatus corresponding to the first embodiment;

FIG. 10 is a flowchart illustrating the contents of a packet retransmission request deciding processing in the terminal apparatus corresponding to the first embodiment;

FIG. 11 is an illustration provided for the explanation of FIG. 10 and showing values of various parameters given to the respective packets that are transmitted from the server corresponding to the first embodiment to the terminal apparatus;

FIG. 12 is a block diagram showing another constitution of the server corresponding to the first embodiment;

FIG. 13 is a block diagram showing another constitution of the terminal apparatus corresponding to the first embodiment;

FIG. 14 is a block diagram showing a constitution of a data transmitting apparatus for a data communication system according to a second embodiment of the invention;

FIG. 15 is a block diagram showing a constitution of a data receiving apparatus for the data communication system according to the second embodiment of the invention;

FIG. 16 is a sequence diagram illustrating a calculating method of the round-trip time RTT in a terminal apparatus corresponding to the second embodiment.

#### Best Mode for Carrying Out the Invention

[0011] Now, referring to the attached figures, embodiments of the invention will be described in detail.

#### (First Embodiment)

[0012] FIG. 1 is a block diagram showing a constitution of a data transmitting apparatus for a data communication system according to the first embodiment of the invention, FIG. 2 is a block diagram showing a constitution of a data receiving apparatus for the same data communication system.

[0013] A data transmitting apparatus 100 shown in FIG. 1 has a function of transmitting a packet via a packet communication channel, which is not shown in the figures, to a data receiving apparatus 200 shown in FIG. 2 as well as receiving controlling data from the data receiving apparatus 200. For example, the data transmitting apparatus 100 is used in a server for data communication being connected to a packet communication channel as a single unit or being mounted in an exchange station apparatus, or a server mounted in a base

station apparatus in a mobile communication system.

[0014] Also, the data receiving apparatus 200 is used, for examples, for an information communication terminal apparatus such as a personal computer, etc., that carries out data transmission/reception via a cable channel, and for a mobile station apparatus, etc., in a mobile communication system (for instance, a mobile telephone and a mobile type information communication terminal apparatus which has a mobile telephone function and a computer function).

[0015] Further, hereinafter, a description is introduced while taking a server and an information communication terminal apparatus at a client side (hereinafter, simply referred to as "terminal apparatus") as an example for a data transmitting apparatus and a data receiving apparatus, respectively.

[0016] The server 100 comprises, as shown in FIG. 1, a receiving section 101, a transmission queue controlling section 102, a packet priority determining section 103, a retransmission buffer 104, a retransmission buffer controlling section 105, a transmitting section 106, a retransmission request receiving section 107, a retransmitability deciding section 108, a round-trip time calculating section 109, a timer 110, a round-trip time transmission deciding section 111 and a packetizing section 112.

[0017] Moreover, the terminal apparatus 200 includes, as shown in FIG. 2, a receiving section 201, a loss detecting section 202, a priority determining section 203, a playback time calculating section 204, a round-trip time receiving section 205, a retransmission request deciding section 206, a time measuring section 207, a time information transmission deciding section 208, a timer 209 and a time information transmitting section 210.

[0018] Then, an operational description will be made to the data communication system having the aforementioned constitution.

[0019] First, the server 100 receives by means of the receiving section 101 packets from own application function such as video/audio coding or the like and own storage function of video/audio data, and outputs the received packets to both transmission queue controlling section 102 and packet priority determining section 103.

[0020] Then, the received packets are subjected to a determining process concerning the priority thereof, and the packets of which priority is determined as high in the packet priority determining section 103 are stored in the retransmission buffer 104. When storing the packets, the retransmission buffer controlling section 105 identifies the packets individually based on the sequence number (serial number) which are given thereto, and controls what addressed memory locations of the retransmission buffer 104 in which the respective packets are stored. The priority of the packets is given to the respective packets by means of the application function.

[0021] On the other hand, when the server 100 receives a packet retransmission request sent from the

terminal apparatus 200 by means of the retransmission request receiving section 107, the server 100 makes a YES/NO decision in the retransmitability section 108 concerning the retransmission of the packet corresponding to the retransmission request which are stored in the retransmission buffer 104. Moreover, responding to the decision result, when it is possible to retransmit the packet which is requested to retransmit, the packet requested to retransmit is read out from the retransmission buffer 104 and outputted to the transmission queue controlling section 102.

[0022] The transmission queue controlling section 102 controls the transmission time of the packet received from the receiving section 101 or from the retransmission buffer 104. The packet controlled by the transmission queue controlling section 102 is transmitted to the terminal apparatus 200 together with the packet from the packetizing section 112 via the transmitting section 106.

[0023] At this time, the server 100 makes a decision, in the round-trip time transmission deciding section 111, whether to transmit the information of the round-trip time RTT (round-trip time of the packet between the server 100 and the terminal apparatus 200) which is calculated in the round-trip time calculating section 109. The contents of the decision process will be described later in detail. Then, when it is decided in the round-trip time transmission deciding section 111 that the round-trip time RTT should be transmitted, the round-trip time RTT which is decided to be transmitted is packetized in the foregoing packetizing section 112 and outputted to the transmitting section 106. The contents of the packetizing process of the round-trip time RTT will be described later in detail.

[0024] Next, referring to the flowchart shown in FIG. 3, a description will be made to the transmitting operation of the round-trip time RTT in the server 100. Further, the transmitting operation of the round-trip time RTT is carried out by the round-trip time calculating section 109, the timer 110, the round-trip time transmission deciding section 111 and the packetizing section 112, which are the essential elements of the invention.

[0025] First of all, in step S1000, the timer 110 is reset and the value of the timer is set to a predetermined initial value (a positive integral number). In the timer 110, when a specific time corresponding to the initial value has passed, the value (value of the timer) becomes "0", and the transmission time of the round-trip time RTT is outputted to the round-trip time transmission deciding section 111 at regular intervals. Precisely, for example, "0" is outputted.

[0026] In step S1100, a decision whether the value of the timer 110 (value of the timer) is "0" is made in the round-trip time transmission deciding section 111. As a result of the decision, when the value of the timer is not "0" (S1100:NO), the relevant decision is continued, i.e., the operation waits, and when the value of the timer is "0" (S1100:YES), the operation proceeds to step S1200.

[0027] In step S1200, in the round-trip time transmission deciding section 111, a decision whether the round-trip time RTT (round-trip time of the packet between the server 100 and the terminal apparatus 200) has newly calculated in the round-trip time calculating section 109 is made. As a result of the decision, when the value of the round-trip time RTT has not been newly calculated, that is to say, when the value of the round-trip time RTT has not been renewed (updated) (S1200:NO), the relevant decision is continued, i.e., the operation waits, and when the value of the round-trip time RTT has been newly calculated, that is to say, when the round-trip time RTT has been renewed (updated) (S1200:YES), the operation proceeds to step S1300. Further, the contents of the calculation process of the round-trip time RTT in the round-trip time calculating section 109 will be described later in detail.

[0028] In step S1300, a decision that the transmission of the round-trip time RTT is OK, i.e., the round-trip time RTT should be transmitted is made in the round-trip time transmission deciding section 111.

[0029] Next, in step S1400, the renewed (updated) round-trip time RTT is packetized in the packetizing section 112. The contents of the packetizing process will be described later in detail.

[0030] Finally, in step S1500, the packet in which the round-trip time RTT is recorded by packetizing is transmitted to the terminal apparatus 200 via the transmitting section 106, and then the operation returns to step S1000.

[0031] Now, referring to FIG. 4 to FIG. 8, a description will be made to the contents of the round-trip time RTT calculating process which is subjected to the decision in step S1200, and to the contents of the packetizing process in step S1400.

[0032] FIG. 4 is a block diagram illustrating a constitution of the round-trip time calculating section 109 of the server 100 (data transmitting apparatus).

[0033] The round-trip time calculating section 109 comprises, as shown in FIG. 4, a first time measuring section 113, a time information receiving section 114, a second time measuring section 115 and a round-trip time calculating section 116.

[0034] The first time measuring section 113 measures the time (server transmission time) T1 when the sender report packet P1 is transmitted from the transmitting section 106 of the server 100 (refer to FIG. 5). The measured server transmission time T1 is packetized together with the round-trip time RTT in the packetizing section 112. That is to say, in the packet P1 that is obtained as a result of packetizing process, the server transmission time T1 is recorded. FIG. 6 shows an example of the packet P1.

[0035] The packet P1 shown in FIG. 6 includes information of version-padding-RC count, payload type, packet length, sender identifier, NTP timestamp, RTP timestamp, cumulative number of packets sent, cumulative number of octets sent and RTT (packet round-trip

time).

[0036] Herein, as an identifier of the payload (information section) type, an identifier indicating a transmitting report packet (PT=200) which is an indication of a time information periodically transmitted from the server 100 rather than an ordinary data is given to the payload type (PT). In the packet length, a packet length measured in 32-bit unit is recorded. In the sender identifier, a sequence of numbers capable of uniquely identifying the sender is recorded. In the NTP timestamp and the RTP timestamp, transmission time of the packet is recorded. In the cumulative number of packets sent, the total number of packets transmitted after the session has begun is recorded. In the cumulative number of octets sent, the total number of octets transmitted after the session has begun is recorded. In the RTT, packet round-trip time calculated in the round-trip time calculating section 109 is recorded.

[0037] Further, the manner of packetizing is not limited to the example shown in FIG. 6. For instance, as shown in FIG. 7, another manner in which an identifier indicating a packet including round-trip time (PT=220) given to the payload type to transmit the round-trip time RTT to the terminal apparatus 200 may be used. In this case, since the packet P1 has only the information of version-padding-RC count, payload type, packet length, sender identifier and RTT packet (round-trip time), the round-trip time can be transmitted to the receiving side as a packet having a fewer amount of information compared to the case shown in FIG. 6. Furthermore, the information may be packetized in another manner and transmitted.

[0038] The time information receiving section 114 receives the receiver report packet P2 transmitted from the terminal apparatus 200 (refer to FIG. 5). In packet P2, the differential time DLSR, which is the time calculated from a point when the terminal apparatus 200 receives the packet P1 to a point when the packet P2 is transmitted, and server transmission time T1 transmitted by the server 100 are recorded. FIG. 8 shows an example of the packet P2.

[0039] The packet P2 shown in FIG. 8 includes the information of version-padding-RC count, payload type, packet length, sender identifier, report receiver identifier, fraction lost, cumulative number of packets lost, highest sequence number received, interarrival jitter, LSR and DLSR.

[0040] Here, as payload type, an identifier indicating the receiver report packet (PT=201) which is an indication of time information and packet loss information or the like transmitted periodically from the terminal apparatus 200 is given. In the packet length, packet length measured in 32-bit unit is recorded. In the sender identifier, a sequence of numbers capable of identifying uniquely the transmitter is recorded, and in the report receiver identifier, a sequence of numbers capable of identifying uniquely the report receiver of the receiver report packet is recorded. In the fraction lost, the ratio

of lost packets to number of packets to be received after the previous receiver report packet has been transmitted is recorded, and in the cumulative number of packets lost, the total number of the lost packets after the session has begun is recorded.

**[0041]** Further, in the highest sequence number received, the SN value of the packet which has the maximum SN among the received packets is recorded. In the jitter, fluctuation of the receiving time of the RTP packet is recorded. In the LSR, the time when the most recent sender report was sent is recorded. In FIG. 5, the latest server transmitting time becomes  $LSR=TT1$ . In the DLSR, the differential time between a point of time when the packet P1 has been received and a point of time when the relevant receiver report packet P2 is transmitted is recorded.

**[0042]** The second time measuring section 115 measures the time (server receiving time) T2 when the packet P2 is received by the time information receiving section 114 (refer to FIG. 5).

**[0043]** The round-trip time calculating section 116 obtains the round-trip time RTT by subtracting the differential time DLSR recorded in the packet P2 and the time T1 from the server receiving time T2. That is to say, the round-trip time  $RTT=T2-DLSR-T1$ .

**[0044]** Herein, the foregoing differential time DLSR is transmitted to the server 100 via the time information transmitting section 210 after being calculated in the terminal apparatus 200 by the time measuring section 207, time information transmission deciding section 208 and timer 209.

**[0045]** Now, referring to the flowchart shown in FIG. 9, a description will be made to the operation in which the differential time DLSR from the reception of packet P1 to the transmission of packet P2 is calculated and transmitted to the server 100 in the terminal apparatus 200.

**[0046]** First, in step S2000, the time parameter is initialized when starting communication. Specifically, the latest packet (transmission report packet P1) reception time TT1 and the latest packet (receiver report packet P2) transmission time TT2 are, respectively, reset to the initial value (=0).

**[0047]** Then, in step S2100, the timer 209 is initialized and the value of the timer is set to a predetermined initial value (positive integral number). When a specific time relative to the initial value has passed, the value (value of the timer) becomes "0", and the timer 209 outputs the transmission time of the differential time DLSR to the time information transmission deciding section 208 at regular intervals. For instance, "0" is output.

**[0048]** Then, in step S2200, the time information transmission deciding section 208 decides whether the value of the timer 209 (value of the timer) is "0". As a result of this decision, when the value of the timer is not "0" (S2200:NO), the relevant decision is continued, i.e., the operation waits, whereas the operation proceeds to step S2300 as the value of the timer is "0" (S2200:YES).

**[0049]** In step S2300, the time information transmission deciding section 208 decides whether the reception time TT1 of the packet P1 from the server 100 has been newly measured by the time measuring section 207, i.e., whether the packet P1 is newly received from the server 100. As a result of this decision, when the packet P1 has not been newly received from the server 100 (S2300:NO), the relevant decision is continued, i.e., the operation waits, whereas the operation proceeds to step S2400 as the packet P1 has been newly received from the server 100 (S2300:YES). Further, the time measuring section 207 measures the reception time TT1 of the packet P1 whenever the terminal apparatus 200 receives the packet P1 from the server 100, and is set (for example, overwritten) to the measured value.

**[0050]** In step S2400, the time information transmission deciding section 208 decides that the transmission of the receiver report packet P2 is OK, i.e., the receiver report packet P2 is to be transmitted, and the packet transmission time TT2 is set to the present time (for example, overwritten).

**[0051]** Then, in the step S2500, by the time measuring section 207, the difference between the packet transmission time TT2 (present time) and the packet reception time TT1 (latest time at which the packet P1 is received) is obtained, and the obtained difference is defined as the differential time DLSR ( $=TT2-TT1$ ).

**[0052]** Finally, in step S2600, after the information of the differential time DLSR is transmitted to the server 100 by the time information transmitting section 210, the operation returns to step S2100.

**[0053]** Now, referring to the flowchart shown in FIG. 10, a description will be made to the operation of the packet retransmission request decision using the round-trip time RTT.

**[0054]** First of all, in step S3000, the packet P1 from the server 100 is received by the receiving section 201.

**[0055]** Herein, each packet P1 transmitted to the terminal apparatus 200 from the server 100, as shown in FIG. 11, is given, respectively, a sequence number SN, sequence number of high priority packet SNHP and priority P. That is to say, in the packets that the terminal apparatus 200 receives from the server 100, a packet which has high priority (high priority) (when  $p=1$ ) and a packet which has low priority (low priority) (when  $p=0$ ) are included, and when transmitting such packets P1, the server 100 increments the sequence number SN recorded in the header field by 1 whenever the packet P1 is transmitted. Further, particularly, when transmitting a high priority packet ( $P=1$ ), the sequence number of the high priority packet SNHP ( $P=1$ ) is also incremented by 1. For example, since the packet of SN=1 has low priority ( $P=0$ ), SNHP=0, whereas the next packet of SN=2 has high priority ( $P=1$ ), the SNHP is incremented by 1 resulted in SNHP=1.

**[0056]** In the next step S3100, the loss detecting section 202 decides whether the sequence number SN of the presently received packet (present SN) is incre-

mented by 1 with respect to the sequence number SN of the previously received packet (previous SN). Responding to the decision result, when the present SN = previous SN+1 (S3100:YES), it is decided that there is no lost packet among the previously received packet, then the operation proceeds to step S3900 and waits for reception. While, when the present SN = previous SN+1 (S3100:NO) is not achieved, it is decided that there is a lost packet among the previously received packet, then the operation proceeds to step S3200, and a decision is made whether to carry out retransmission request of the lost packet.

[0057] In step S3200, the priority determining section 203 determines whether the priority of the received packet is high (P=1). As a result of the determination process, when the priority of the received packet is not high, i.e., when it is low priority (P=0) (S3200:NO), the operation proceeds to step S3300, whereas the operation proceeds to step S3400 when the priority of the received packet is high, i.e., when it is high priority (P=1) (S3200:YES).

[0058] In step S3300, since the received packet has low priority (P=0), the SN is incremented by 1 whereas SNHP is not incremented as long as there is no lost packet, and it is decided whether the sequence number of the high priority packet of the presently received packet (present SNHP) is equal to the sequence number of the high priority packet of the previously received packet (previous SNHP). According to decision result, when present SNHP = previous SNHP (S3300:YES), it is decided that there is no loss of high priority packet, then the operation proceeds to step S3900 and waits for reception. On the contrary, when present SNHP = previous SNHP (S3300:NO) is not achieved, it is decided that there is a loss of high priority packet, and the operation proceeds to step S3500.

[0059] While, in step S3400, since the received packet has high priority (P=1), both SN and SNHP are incremented by 1 as long as there is no loss, it is decided whether the sequence number of the high priority packet of the presently received packet (present SNHP) has been incremented by 1 with respect to the sequence number of the high priority packet of the previously received packet (previous SNHP). As a result of the decision, when present SNHP = previous SNHP + 1 (S3400:YES), it is decided that there is no loss of high priority packet, then the operation proceeds to step S3900 and waits for reception. On the contrary, when present SNHP = previous SNHP + 1 (S3400:NO) is not achieved, it is decided that there is a loss of high priority packet, then the operation proceeds to step S3500.

[0060] In step S3500, the playback time calculating section 204 calculates the playback time PLT (=TS-TSO) of the packet by calculating the difference between the timestamp TS of the presently received packet and the timestamp TSO at time when the session has begun to calculate a relative time assuming the time when the session has begun is "0".

[0061] In the following step S3600, the retransmission request deciding section 206 reads out the data round-trip time RTT from the server 100 received by the round-trip time receiving section 205 from the buffer in the round-trip time receiving section 205.

[0062] Next, in step S3700, the retransmission request deciding section 206 decides whether the playback time PLT calculated in step S3500 is less than the sum of the round-trip time RTT read out in step S3600 and the present time, i.e., whether playback time PLT < round-trip time RTT + present time.

[0063] When playback time PLT < round-trip time RTT + present time (step S3600:YES) as a result of the decision, it is determined that a wasteful retransmission request is not made even when the retransmission request is for the lost packet, since the playback time comes earlier than the time when the retransmission request is received, then the operation proceeds to step S3900 and waits for reception.

[0064] On the contrary, when the playback time PLT < round-trip time RTT + present time (step S3600:NO), the playback time comes later than the reception time of the repeat packet, and since it is possible to execute playback after receiving the repeat packet, the process proceeds to step S3800 and the retransmission request for the lost packet is transmitted to the server 100 by the retransmission request deciding section 206.

[0065] As described above, according to the data communication system of the first embodiment, it is possible to eliminate the transmission of wasteful data that is later than the playback time at the receiving side by executing the retransmission request of the lost packet having high priority only when the sum of the round-trip time RTT and the present time is less than the playback time of the packet after calculating the round-trip time RTT of the packet between the server 100 and the terminal apparatus 200, thus, the wasteful utilization of transmission band can be eliminated.

[0066] However, according to the first embodiment, although the retransmitting decision is carried out only when the lost packet is the high priority packet, it is not limited to this. It may be carried out the retransmitting decision for all lost packets regardless to the priority of packets.

[0067] Furthermore, it is conceivable that the first embodiment includes several modifications thereof. FIG. 12 is a block diagram showing another constitution of the data transmitting apparatus (server), and FIG. 13 is a block diagram showing another constitution of the data receiving apparatus (terminal apparatus). Further, herein also, the description will be made while assuming a server and a terminal apparatus as an example of data transmitting apparatus and data receiving apparatus, respectively.

[0068] The characteristic (main feature) of the server 100a shown in FIG. 12 is that the server 100a includes a communication status monitoring section 117 and a time interval altering section 118. The communication

status monitoring section 117 monitors the communication status of the packet, and the time interval altering section 118 alters the intervals in order to initialize the timer 110, i.e., the time for transmitting the round-trip time RTT, depending on the communication status which is inputted from the communication status monitoring section 117. For example, in case of bad communication status, the time intervals for transmitting the round-trip time RTT is shortened. Accordingly, even when the communication status is bad, the round-trip time RTT can be transmitted satisfactorily to the terminal apparatus 200.

[0069] Furthermore, as another constitution, although it is not shown among the figures, it may be adapted so that the time interval altering section 118 alters the time intervals for transmitting the round-trip time RTT to the terminal apparatus 200 in accordance with a difference between the present and previous round-trip times calculated in the round-trip time calculating section 109. For instance, when the difference between the calculated present and previous round-trip times is small, by elongating the time intervals for transmitting the round-trip time RTT, the utilization of transmission band can be reduced.

[0070] Still further, a characteristic of the terminal apparatus 200a shown in FIG. 13 is that, apparatus 200a includes instead of time measuring section 207, time information transmission deciding section 208, timer 209 and time information transmitting section 210 shown in FIG. 2, the terminal apparatus 200a includes an initial round-trip time storing section 211 and a round-trip time selecting section 212. The initial round-trip time storing section 211 stores a lower limit value and an upper limit value of the round-trip time RTT as an initial value. When the round-trip time RTT is received in the round-trip time receiving section 205, by testing whether the received round-trip time RTT is within the range between the lower and upper limit values stored in the initial round-trip time storing section 211, the round-trip time selecting section 212 selects only the round-trip time RTT that is within the aforementioned range and outputs it to the retransmission request deciding section 206. On account of this, the round-trip time RTT is maintained within a proper range even when it is not received correctly due to transmission route error, time measurement error, etc., therefore, the influence caused by an erroneous round-trip time RTT can be reduced.

[0071] Still furthermore, as another constitution, although it is not shown among the figures, a time interval altering section may be provided to the terminal apparatus 200 shown in FIG. 2, which alters the intervals of initializing the timer 209, i.e., alters the time intervals for transmitting the differential time DLSR to the server 100 in the time information transmitting section 210 in accordance with a difference between the present and previous round-trip times received by the round-trip time receiving section 205. Owing to this, for example, when a difference between the present and previous round-

trip times is small, the utilization of transmission band can be reduced by elongating the transmission intervals used for transmitting the differential time DLSR.

#### 5 (Second Embodiment)

[0072] FIG. 14 is a block diagram showing a constitution of a data transmitting apparatus for a data-communication system according to the second embodiment of the present invention, FIG. 15 is a block diagram showing a constitution of a data receiving apparatus for the same data communication system. Further, since the data transmitting apparatus and data receiving apparatus of the data-communication system has the same basic constitution as those of the corresponding data transmitting apparatus and the data receiving apparatus according to the first embodiment shown in FIG. 1 and FIG. 2, the same component elements thereof are assigned the same reference numerals and descriptions thereof are omitted. Furthermore, in the second embodiment also, description will be made while taking, respectively, a server and terminal as an example of the data transmitting apparatus and data receiving apparatus.

[0073] The server 300 shown in FIG. 14 includes, in addition to the receiving section 101, transmission queue controlling section 102, packet priority determining section 103, retransmission buffer 104, retransmission buffer controlling section 105, transmitting section 106, retransmission request receiving section 107 and retransmitability deciding section 108 shown in FIG. 1, and instead of the round-trip time-calculating section 109, timer 110, round-trip time transmission deciding section 111 and packetizing section 112 shown in FIG. 1, includes a time measuring section 207, time information transmission deciding section 208, timer 209 and time information transmitting section 210 shown in FIG. 2.

[0074] Moreover, the terminal apparatus 400 shown in FIG. 15 includes, in addition to the receiving section 201, loss detecting section 202, priority determining section 203, playback time calculating section 204, round-trip time receiving section 205 and retransmission request deciding section 206 shown in FIG. 2, and instead of the time measuring section 207, time information transmission deciding section 208, timer 209 and time information transmitting section 210 shown in FIG. 2, the first time measuring section 113, time information receiving section 114, second time measuring section 115 and round-trip time calculating section 116 shown in FIG. 4, and the timer 110, round-trip time transmission deciding section 111 and packetizing section 112 shown in FIG. 1.

[0075] That is to say, the second embodiment adopts a constitution in which the round-trip time RTT is calculated by the terminal apparatus 200.

[0076] Next, an operational description of the data communication system having the foregoing constitution



tion is given below.

[0077] First, when calculating the round-trip time RTT, the terminal apparatus 400 measures the time T1 (terminal apparatus transmission time) when the packet P1 is transmitted from the relevant terminal apparatus 400 (referring to FIG. 16) in the first time measuring section 113.

[0078] Then, the packet P2 transmitted from the server 300 is received by the time information receiving section 114. In the packet P2, both the differential time DLSR measured from the time when the server 300 has received the packet P1 to the time when the packet P2 is transmitted to the terminal apparatus 400 and terminal apparatus transmission time T1 transmitted by the terminal apparatus 400 are recorded.

[0079] Next, in the second time measuring section 115, the time T2 (terminal apparatus reception time) when the packet P2 is received by the time information receiving section 114 is measured (referring to FIG. 16).

[0080] After that, the round-trip time calculating section 116 calculates the round-trip time by subtracting the differential time DLSR recorded in the packet P2 and the terminal apparatus transmission time T1 from the terminal apparatus reception time T2, the round-trip time RTT (=T2-DLSR-T1) and the obtained result is outputted to the round-trip time receiving section 205.

[0081] On the other hand, whenever the timer 209 is reset after a specific time has passed, i.e., at regular intervals, the server 300 outputs the transmission time of the differential time DLSR to the time information transmission deciding section 208.

[0082] The time information transmission deciding section 208 decides whether the packet P1 from the terminal apparatus 400 has been newly received by the time measuring section 207 at every transmission time transmitted from the timer 209, and when the packet P1 has been received, the packet transmission time TT2 is set as the present time.

[0083] Then, the time measuring section 207 obtains the difference between the packet transmission time TT2 (present time) and the packet reception time TT1 (the latest time when the packet P1 is received) and the obtained difference is defined as the differential time DLSR (=TT2-TT1).

[0084] Next, the time information transmitting section 210 transmits the differential time DLSR to the terminal apparatus 400.

[0085] Since the other operations thereof are the same as that of the data communication system corresponding to the first embodiment, the description thereof is omitted.

[0086] As described above and according to the data communication system of the second embodiment, it is possible to eliminate the transmission of wasteful data that is later than the playback time at the receiving side by executing the retransmission request of the lost packet having the high priority only when the sum of the round-trip time RTT and the present time is less than

the playback time of the packet after calculating the round-trip time RTT of the packet between the server 300 and the terminal apparatus 400, thus the wasteful utilization of transmission band can be eliminated.

[0087] Further, in the second embodiment, although the retransmission decision is carried out only when the lost packet is of high priority, it is not limited to this, but also it may be carried out on every lost packet regardless to the priority of the packet.

[0088] Furthermore, in the respective foregoing embodiments, the data communication system is composed of data transmitting apparatus (server) 100 or 300 and data receiving apparatus (terminal apparatus) 200 or 400, the data communication system is not limited to this. For example, a composition in which a relay apparatus is provided between the data transmitting apparatus and data receiving apparatus may be adopted.

[0089] The description of the invention is based on both, the Japanese Patent Application No. 2000-207296 filed on July 7, 2000 and the Japanese Patent Application No. 2001-199621 filed on June 29, 2000. Entire content of the above is expressly incorporated by reference herein.

#### Industrial Applicability

[0090] The present invention is applicable to a data transmitting apparatus and a data receiving apparatus in a data communication system.

#### Claims

##### 1. A data transmitting apparatus, comprising:

storing means for storing a retransmittable data only;  
retransmitting means for retransmitting a data that is extracted from the data stored in said storing means corresponding to a retransmission request of a receiving side;  
calculating means for calculating a data round-trip time between the receiving side and the data transmitting apparatus; and  
transmitting means for transmitting the data round-trip time calculated by said calculating means to the receiving side at a predetermined time interval.

2. The data transmitting apparatus according to claim 1, wherein the retransmittable data is a data that has high priority.

3. The data transmitting apparatus according to claim 1, wherein said calculating means comprises:

means for measuring transmission time of a first data to be transmitted to the receiving side;

means for measuring reception time of a second data transmitted from the receiving side in response to the first data; and  
 means for calculating the data round-trip time by subtracting a differential time between reception time of the first data at the receiving side and transmission time of the second data, the differential time being included in the second data, and the measured first data transmission time from the measured second data reception time.

4. The data transmitting apparatus according to claim 3, wherein said calculating means calculates, when the measured first data transmission time is transmitted to the receiving side and the first data transmission time is included in the second data together with the differential time, the data round-trip time using the first data transmission time included in the second data.

5. The data transmitting apparatus according to claim 1, further comprising packetizing means for packetizing the data round-trip time calculated by said calculating means together with other information to form a single packet, and wherein said transmitting means transmits the single packet formed by said packetizing means to the receiving side at a predetermined time interval.

6. The data transmitting apparatus according to claim 1, further comprising:

monitoring means for monitoring the status of data communication; and  
 altering means for altering the time interval at which the data round-trip time calculated by said calculating means is transmitted to the receiving side in accordance with the result of the monitoring by said monitoring means.

7. The data transmitting apparatus according to claim 1, further comprising altering means that includes means for holding the data round-trip time calculated by said calculating means and for altering the time interval at which a present data round-trip time calculated by said calculating means is transmitted to the receiving side in accordance with a time difference between the present data round-trip time and a previous data round-trip time calculated by said calculating means.

8. A data transmitting apparatus, comprising:

storing means for storing a retransmittable data only;  
 retransmitting means for retransmitting a data that is extracted from the data stored in said

storing means corresponding to a retransmission request of a receiving side;  
 measuring means for measuring a differential time between reception time of a first data transmitted from the receiving side and transmission time of a second data to be transmitted to the receiving side in response to the first data; and  
 transmitting means for transmitting the differential time measured by said measuring means included in the second data to the receiving side at a predetermined time interval.

9. A data receiving apparatus, comprising:

receiving means for receiving a data;  
 loss detecting means for detecting loss of data when the data is received by said receiving means;  
 playback time calculating means for calculating playback time of the data received by said receiving means;  
 round-trip time receiving means for receiving a data round-trip time between a transmitting side and the data receiving apparatus; and  
 retransmission request deciding means for deciding, when a lost data is detected by said loss detecting means, whether a retransmission request for the lost data is made or not based on the playback time calculated by said playback time calculating means and the data round-trip time received by said data round-trip time receiving means.

10. The data receiving apparatus according to claim 9, further comprising priority determining means for determining, when a lost data is detected by said loss detecting means, the priority of the lost data, and wherein said retransmission request deciding means decides whether the retransmission request is made or not for the lost data which is determined by said priority determining means that the priority thereof is not less than a predetermined value.

11. The data receiving apparatus according to claim 9, further comprising:

measuring means for measuring a differential time between reception time of a first data transmitted from a transmitting side and transmission time of a second data to be transmitted to the transmitting side in response to the first data; and  
 transmitting means for transmitting the differential time measured by said measuring means included in the second data to the transmitting side at a predetermined time interval.

12. The data receiving apparatus according to claim 9, further comprising transmission time receiving means for receiving transmission time of the first data transmitted from the transmitting side, and wherein said transmitting means transmits the transmission time received by said transmission time receiving means together with the differential time measured by said measuring means to the transmitting side at the predetermined time interval.

13. The data receiving apparatus according to claim 9, further comprising:

storing means for storing a lower limit value and an upper limit value of the data round-trip time; and  
selecting means for selecting only a data round-trip time that is within a range between the lower limit value and the upper limit value stored in said storing means from the data round-trip time received by said data round-trip time receiving means, and

wherein said retransmission request deciding means decides, when a lost data is detected by said loss detecting means, whether the retransmission request for the lost data is made or not based on the playback time calculated by said playback time calculating means and the data round-trip time selected by said selecting means.

14. The data receiving apparatus according to claim 11, further comprising altering means that includes means for holding the data round-trip time received by said data round-trip time receiving means and for altering the time interval at which the differential time measured by said measuring means is transmitted to the transmitting side in accordance with a time difference between a present data round-trip time and a previous data round-trip time that are received by said round-trip time receiving means.

15. A data receiving apparatus, comprising:

calculating means for calculating a data round-trip time between a transmitting side and the data receiving apparatus by subtracting transmission time of a first data transmitted to the transmitting side and a differential time between reception time of the first data at the transmitting side and transmission time of a second data transmitted from the transmitting side, the differential time being included in the second data, from reception time of the second data;  
receiving means for receiving a data;  
loss detecting means for detecting loss of data when the data is received by said receiving

means;  
playback time calculating means for calculating playback time of the data received by said receiving means; and  
retransmission request deciding means for deciding, when a lost data is detected by said loss detecting means, whether a retransmission request for the lost data is made or not based on the playback time calculated by said playback time calculating means and the data round-trip time calculated by said calculating means.

16. A base station apparatus including the data transmitting apparatus in any one of claims 1 through 8.

17. An information communication terminal apparatus including the data receiving apparatus in any one of claims 9 through 15.

18. A mobile station apparatus including the data receiving apparatus in any one of claims 9 through 15.

19. A data communication system comprising a data transmitting apparatus and a data receiving apparatus,  
wherein the data transmitting apparatus comprises:

storing means for storing a retransmittable data only;  
retransmitting means for retransmitting a data that is extracted from the data stored in said storing means corresponding to a retransmission request of the data receiving apparatus;  
calculating means for calculating a data round-trip time between the data receiving apparatus and the data transmitting apparatus; and  
transmitting means for transmitting the data round-trip time calculated by said calculating means to the data receiving apparatus at a predetermined time interval, and

wherein the data receiving apparatus comprises:

receiving means for receiving the data transmitted from the data transmitting apparatus;  
loss detecting means for detecting loss of data when the data is received by said receiving means;  
playback time calculating means for calculating playback time of the data received by said receiving means;  
round-trip time receiving means for receiving the data round-trip time transmitted from said transmitting means; and  
retransmission request deciding means for deciding, when a lost data is detected by said loss

detecting means, whether a retransmission request for the lost data is made or not based on the playback time calculated by said playback time calculating means and the data round-trip time received by said round-trip time receiving means.

20. A data communication system comprising a data transmitting apparatus and a data receiving apparatus,

wherein the data transmitting apparatus comprises:

storing means for storing a retransmittable data only;  
 retransmitting means for retransmitting a data that is extracted from the data stored in said storing means corresponding to a retransmission request of the data receiving apparatus;  
 measuring means for measuring a differential time between reception time of a first data transmitted from the data receiving apparatus and transmission time of a second data to be transmitted to the data receiving apparatus in response to the first data; and  
 transmitting means for transmitting the differential time measured by said measuring means included in the second data to the data receiving apparatus at a predetermined time interval, and

wherein the data receiving apparatus comprises:

calculating means for calculating a data round-trip time between the data transmitting apparatus and the data receiving apparatus by subtracting transmission time of the first data transmitted to the data transmitting apparatus and the differential time included in the second data transmitted from the data transmitting apparatus from reception time of the second data;  
 receiving means for receiving the data transmitted from the data transmitting apparatus;  
 loss detecting means for detecting loss of data when the data is received by said receiving means;  
 playback time calculating means for calculating playback time of the data received by said receiving means; and  
 retransmission request deciding means for deciding, when a lost data is detected by said loss detecting means, whether a retransmission request for the lost data is made or not based on the playback time calculated by said playback time calculating means and the data round-trip time calculated by said calculating means.

21. The data communication system according to claim 19 or 20, further comprising priority determining means for determining, when a lost data is detected by said loss detecting means, the priority of the lost data, and wherein said retransmission request deciding means decides whether the retransmission request is made or not for the lost data which is determined by said priority determining means that the priority thereof is not less than a predetermined value.

22. A data communication method in a data communication system comprising a data receiving apparatus and a data transmitting apparatus that retransmits a data which is extracted from the data stored in storing means for storing a retransmittable data only corresponding to a retransmission request of the data receiving apparatus, said method comprising:

a calculating step in which the data transmitting apparatus calculates a data round-trip time between the data receiving apparatus and the data transmitting apparatus;  
 a transmitting step in which the data transmitting apparatus transmits the data round-trip time calculated in the calculating step to the data receiving apparatus at a predetermined time interval;  
 a receiving step in which the data receiving apparatus receives the data transmitted from the data transmitting apparatus;  
 a loss detecting step in which the data receiving apparatus detects loss of data when the data is received in the receiving step;  
 a playback time calculating step in which the data receiving apparatus calculates playback time of the data received in the receiving step;  
 a round-trip time receiving step in which the data receiving apparatus receives the data round-trip time transmitted in the transmitting step; and  
 a retransmission request deciding step in which the data receiving apparatus decides, when a lost data is detected in the loss detecting step, whether a retransmission request for the lost data is made or not based on the playback time calculated in the playback time calculating step and the data round-trip time received in the round-trip time receiving step.

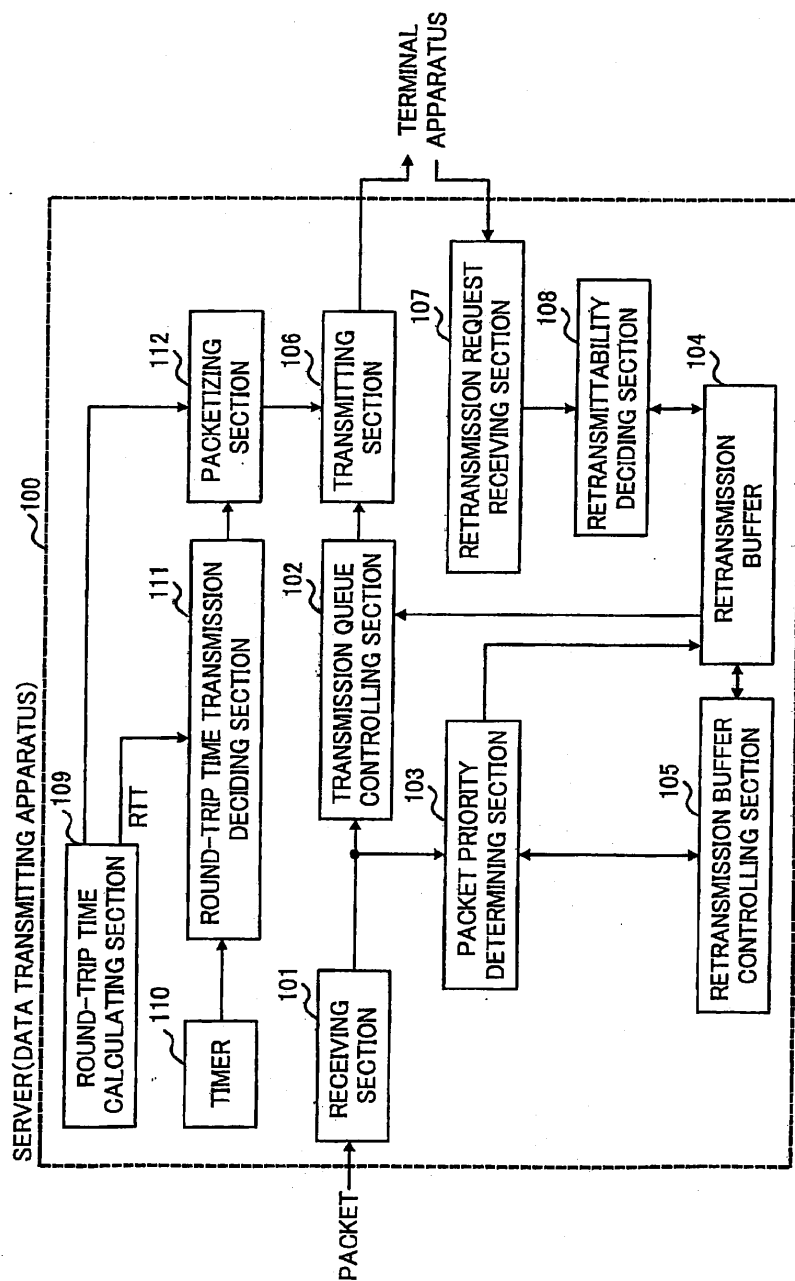
23. A data communication method in a data communication system comprising a data receiving apparatus and a data transmitting apparatus that retransmits a data which is extracted from the data stored in storing means for storing a retransmittable data only corresponding to a retransmission request of the data receiving apparatus, said method comprising:

ing:

a measuring step in which the data transmitting apparatus measures a differential time between reception time of a first data transmitted from the data receiving apparatus and transmission time of a second data to be transmitted to the data receiving apparatus in response to the first data; 5  
 a transmitting step in which the data transmitting apparatus transmits the differential time measured in the measuring step included in the second data to the data receiving apparatus at a predetermined time interval; 10  
 a calculating step in which the data receiving apparatus calculates a data round-trip time between the data transmitting apparatus and the data receiving apparatus by subtracting transmission time of the first data transmitted to the data transmitting apparatus and the differential time included in the second data transmitted from the data transmitting apparatus from reception time of the second data; 15  
 a receiving step in which the data receiving apparatus receives the data transmitted from the data transmitting apparatus; 20  
 a loss detecting step in which the data receiving apparatus detects loss of data when the data is received in the receiving step; 25  
 a playback time calculating step in which the data receiving apparatus calculates playback time of the data received in the receiving step; 30  
 and  
 a retransmission request deciding step in which the data receiving apparatus decides, when a lost data is detected in the loss detecting step, whether a retransmission request for the lost data is made or not based on the playback time calculated in the playback time calculating step and the data round-trip time calculated in the calculating step. 35 40

24. The data communication method in the data communication system according to claim 22 or 23, further comprising a priority determining step in which the data receiving apparatus determines, when a lost data is detected in the loss detecting step, the priority of the lost data, and wherein in the retransmission request deciding step it is decided whether the retransmission request is made or not for the lost data which is determined in the priority determining step that the priority thereof is not less than a predetermined value. 45 50

55



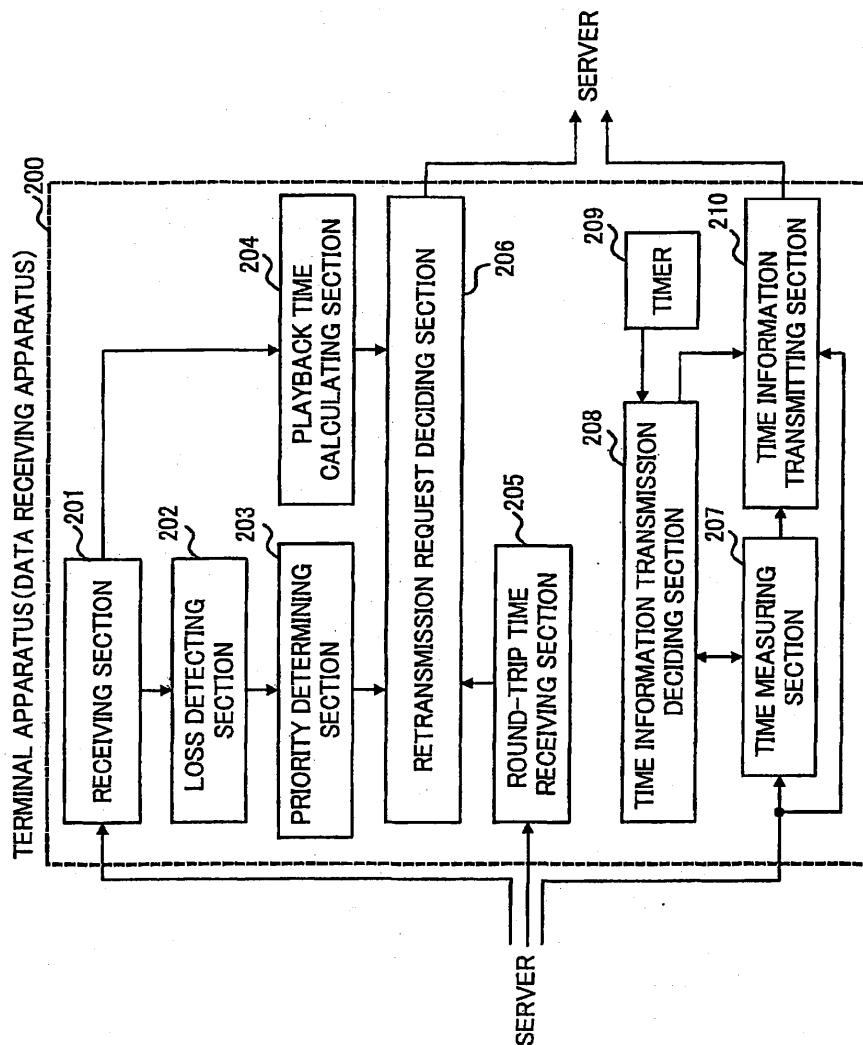


FIG.2

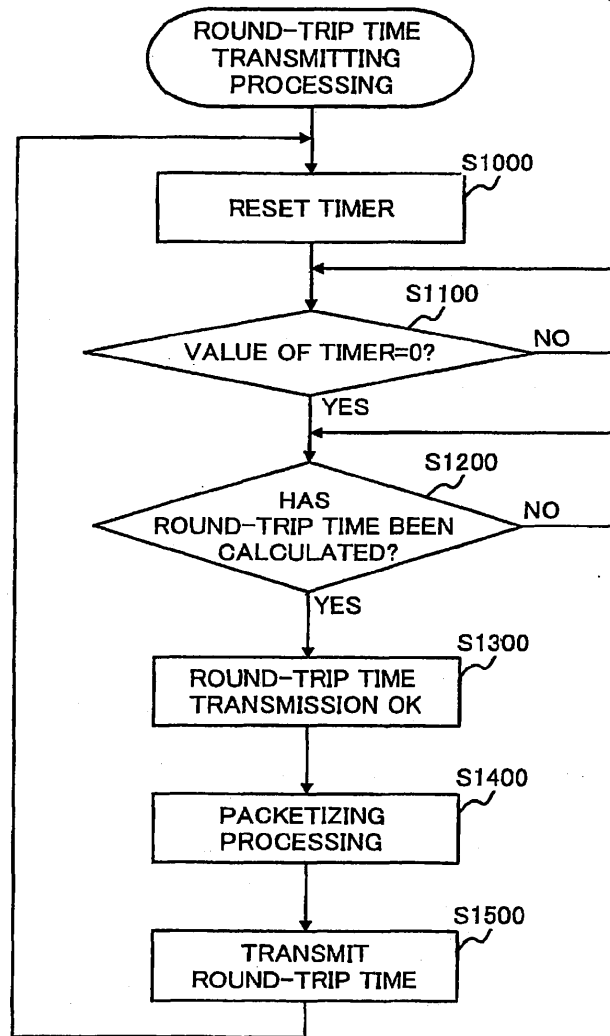


FIG.3



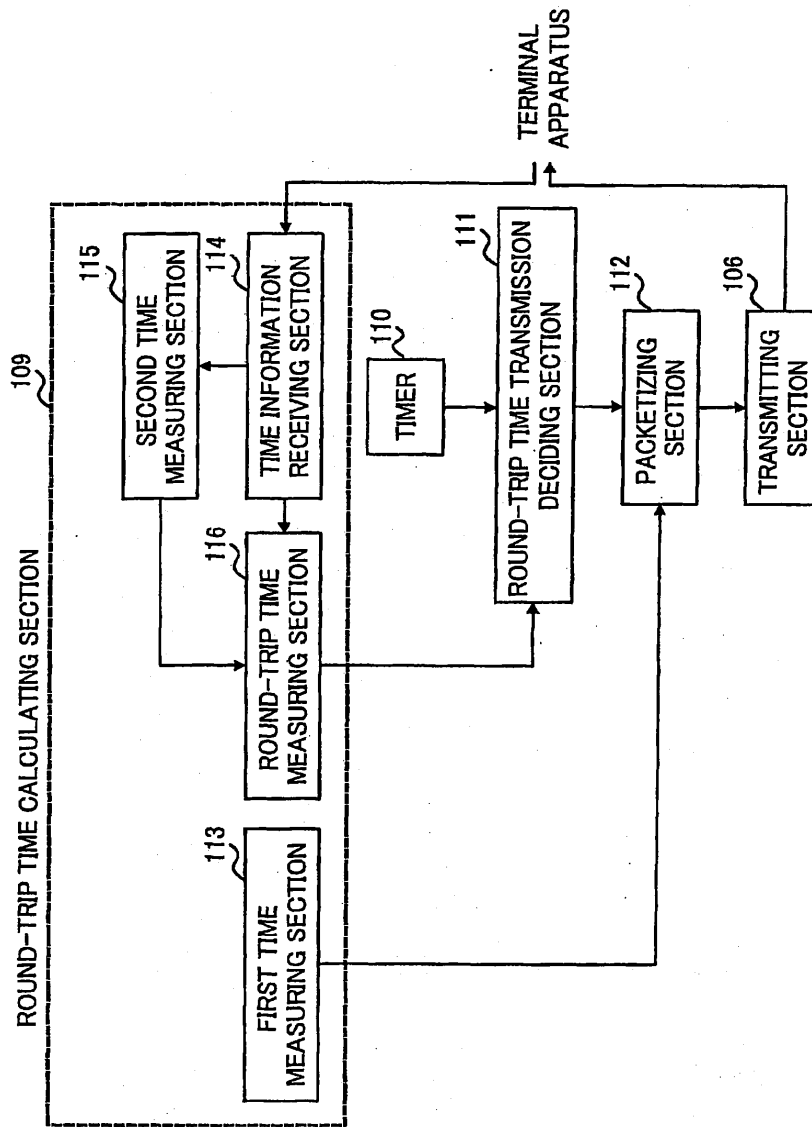


FIG.4

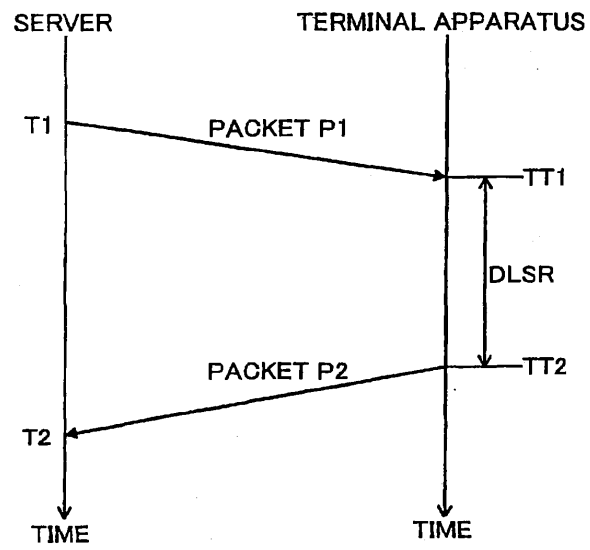


FIG.5

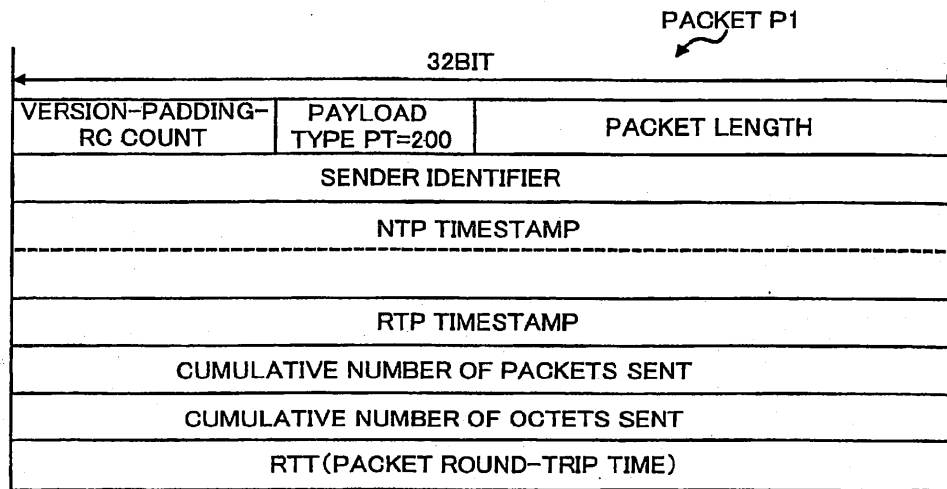


FIG.6

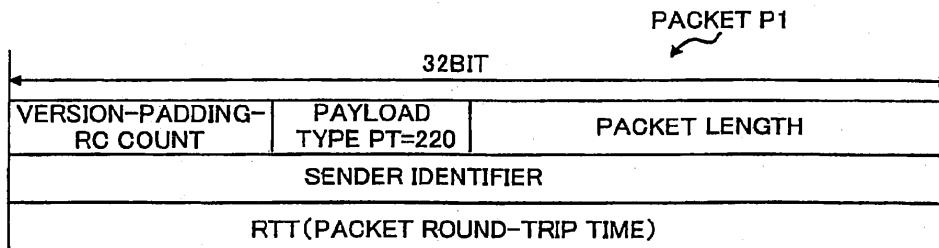


FIG.7

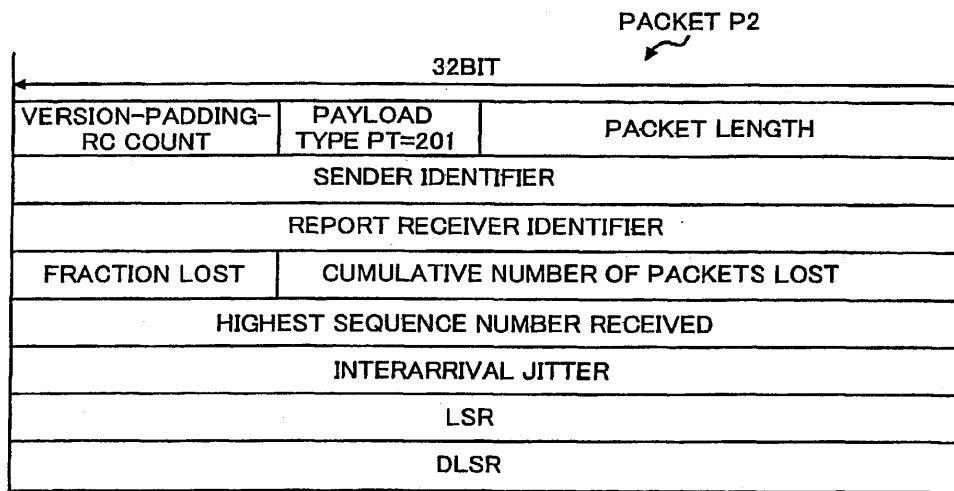


FIG.8

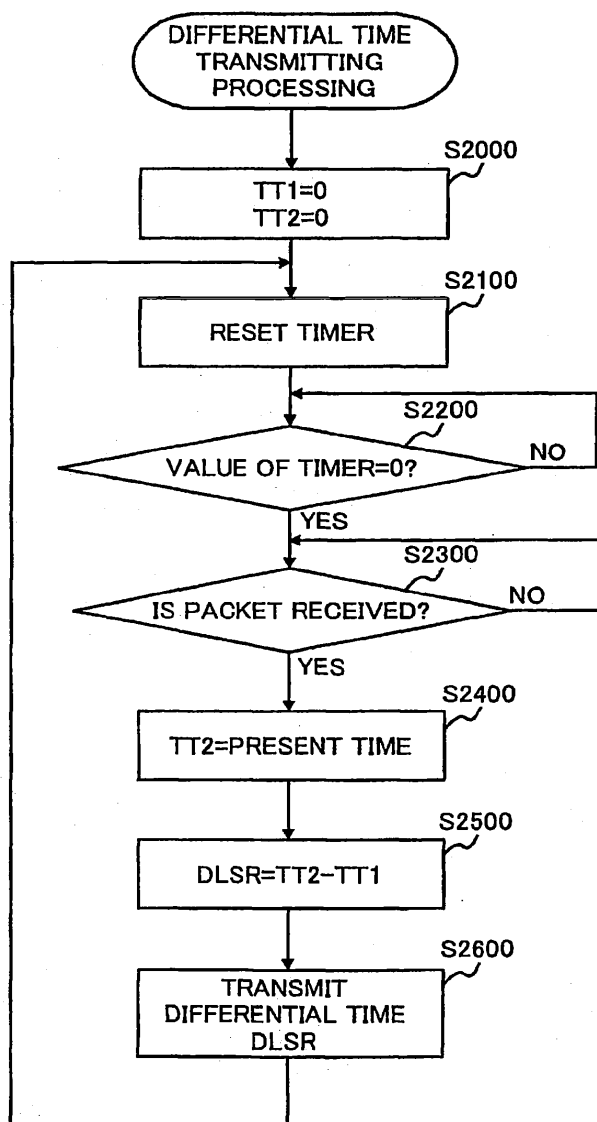


FIG.9

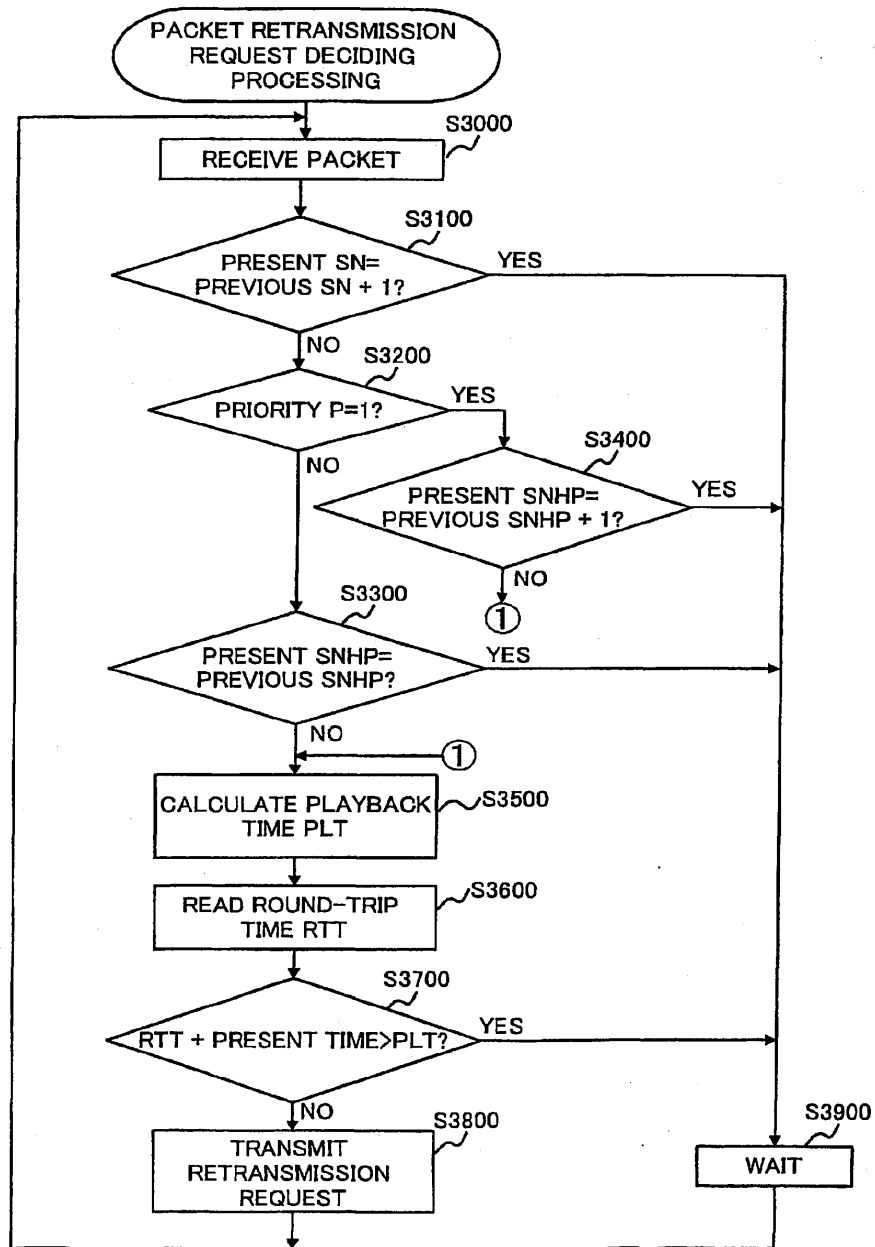


FIG.10

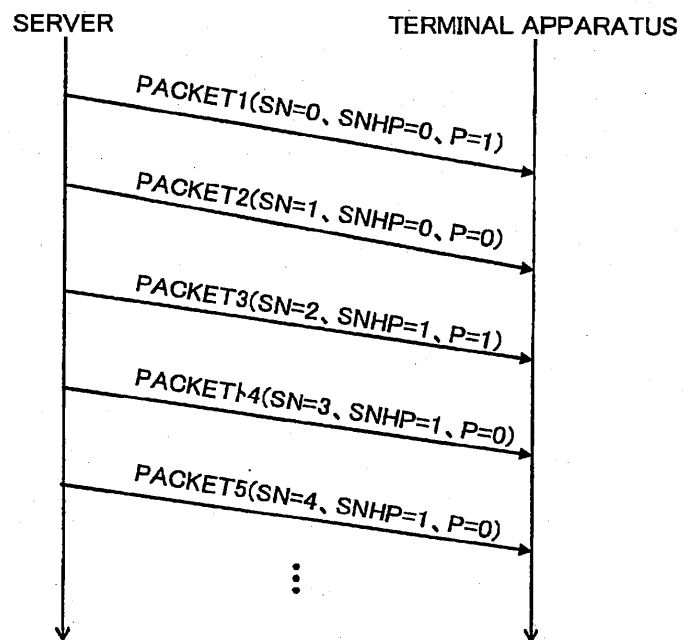


FIG.11

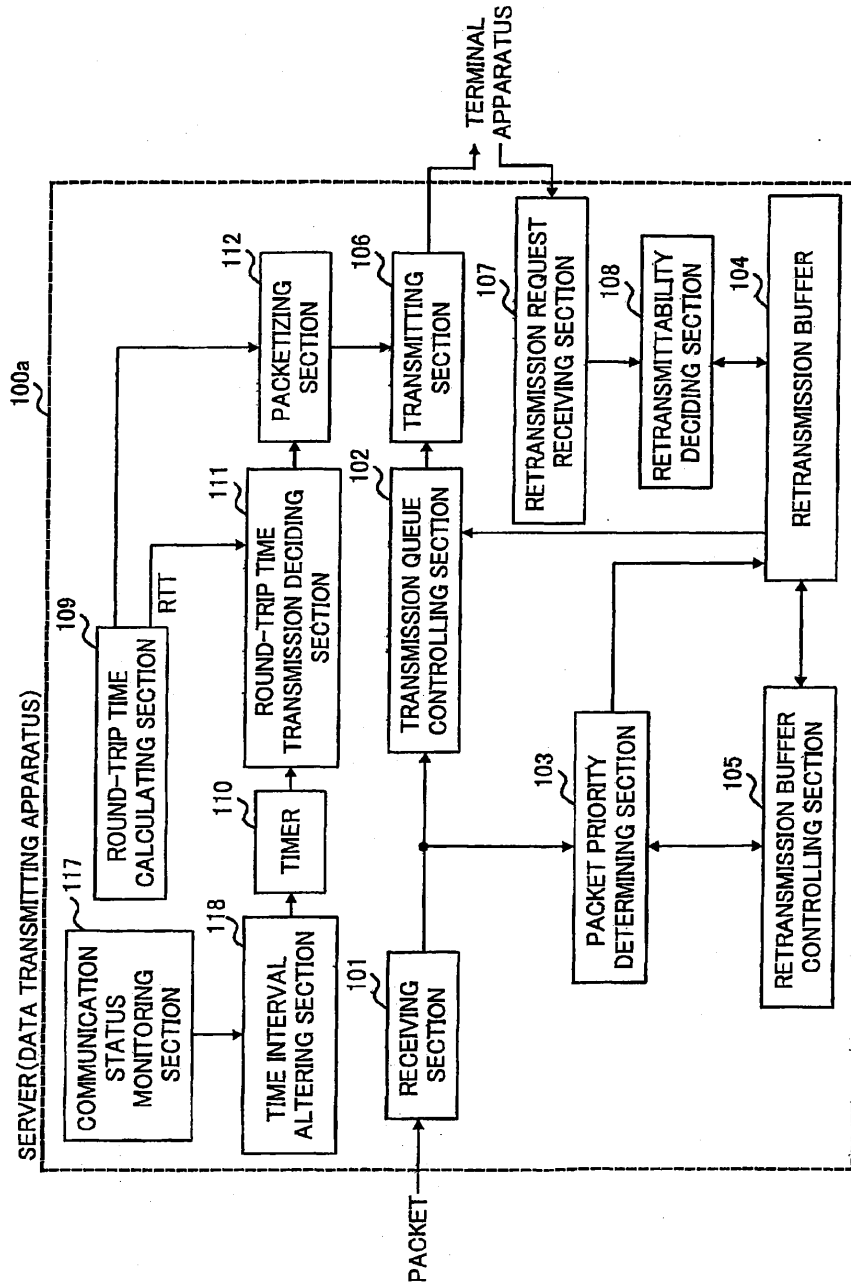


FIG.12



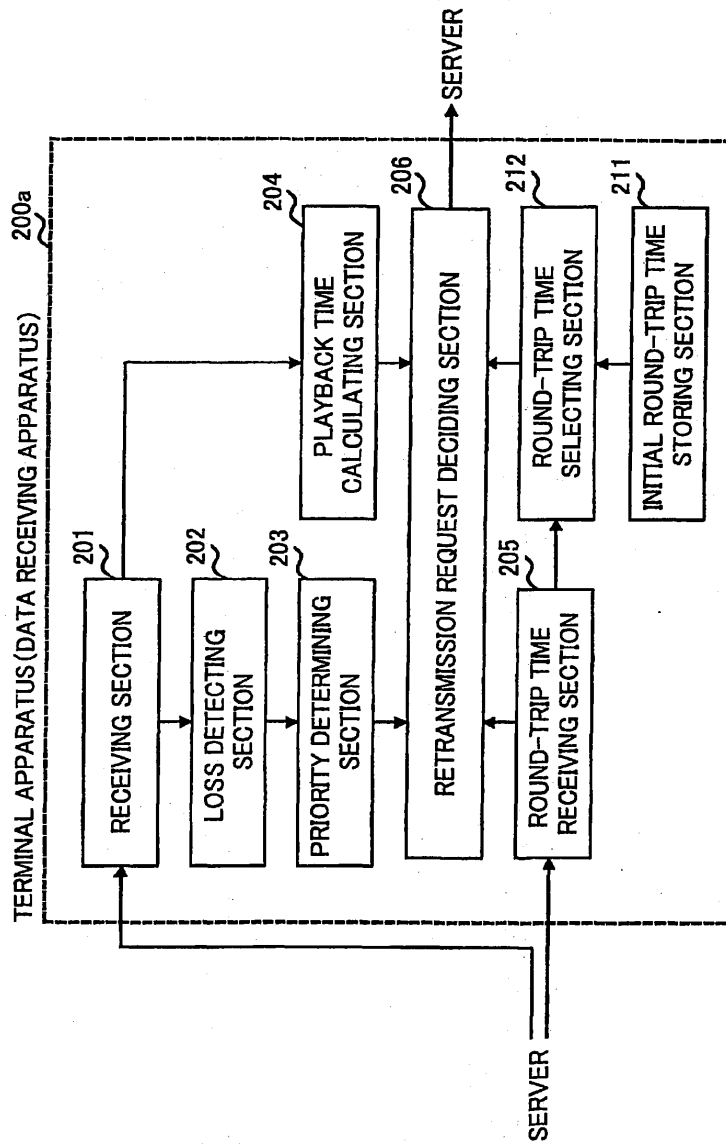


FIG.13

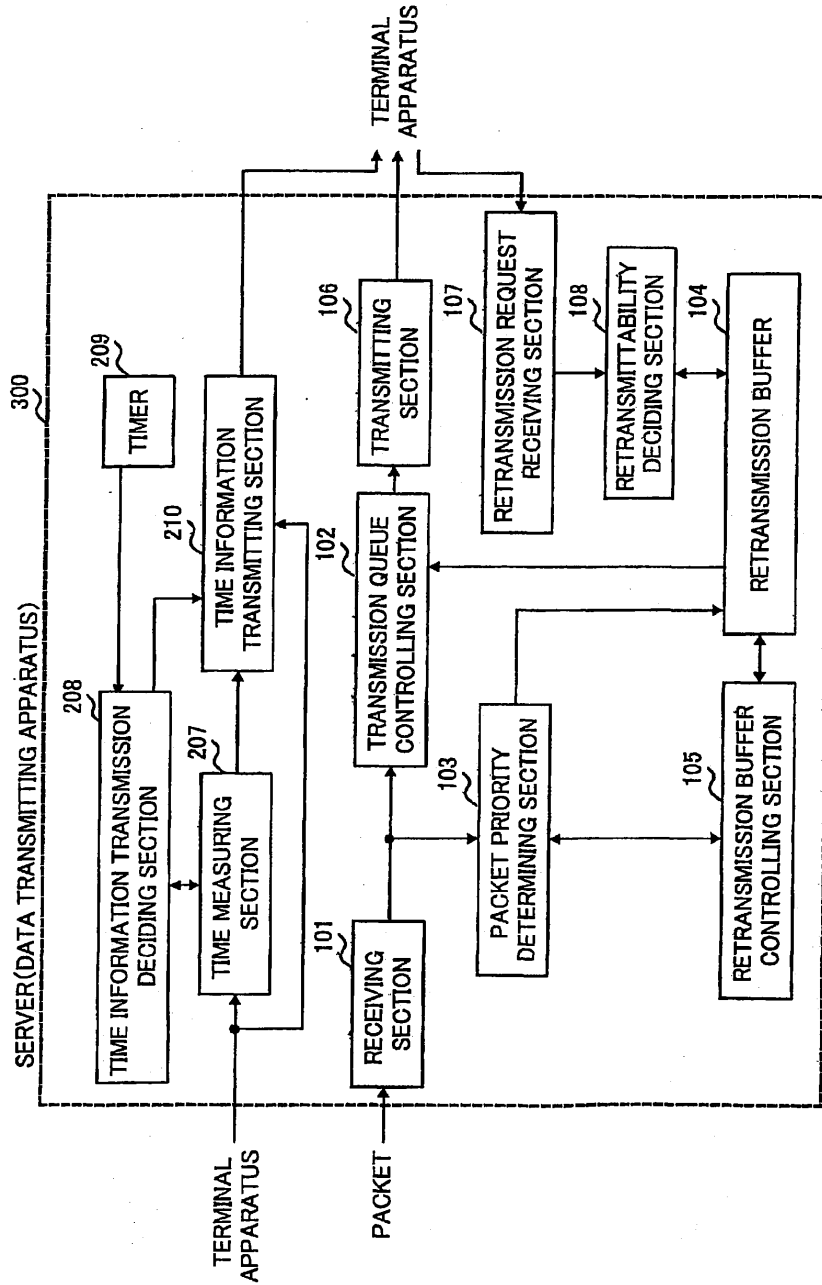


FIG.14

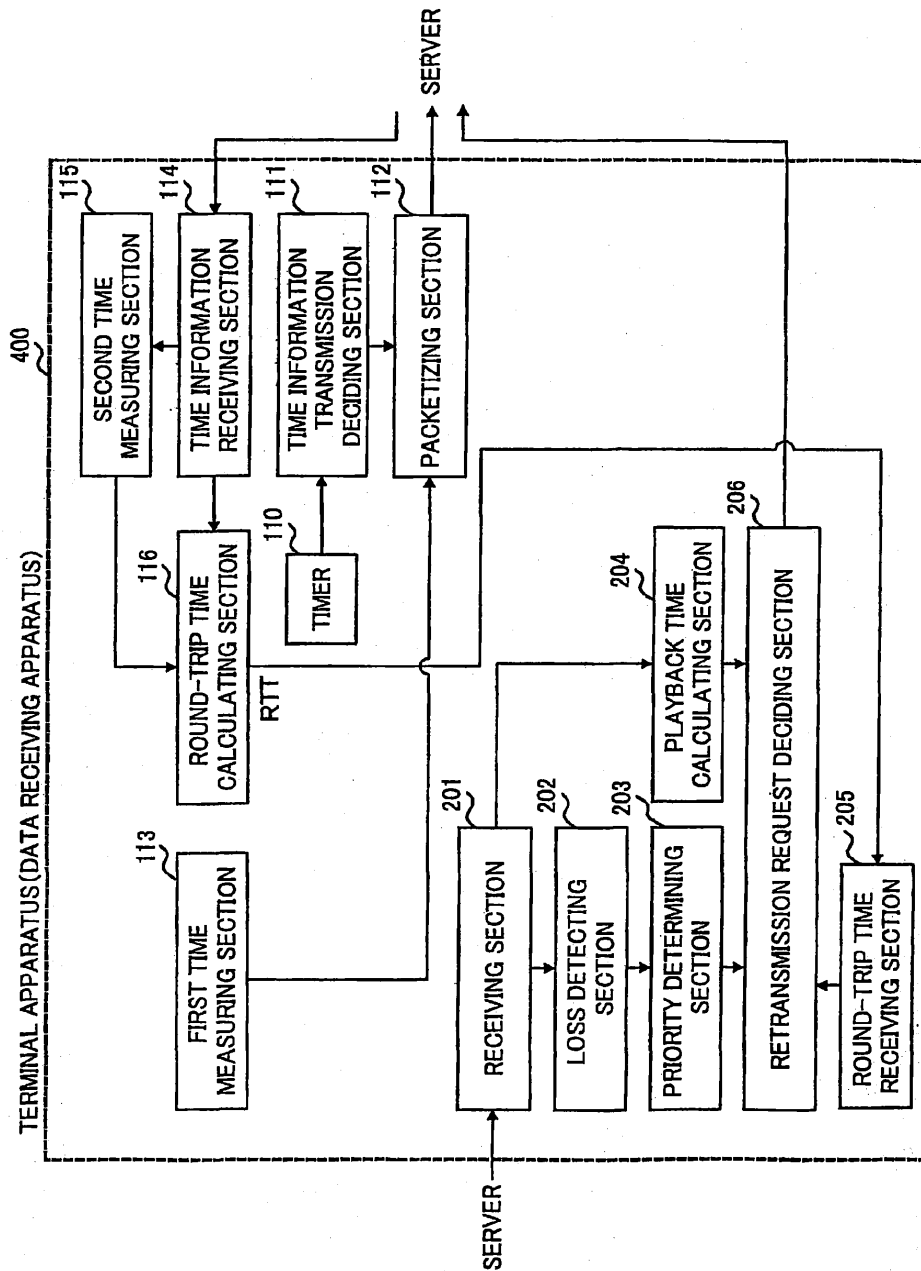


FIG.15

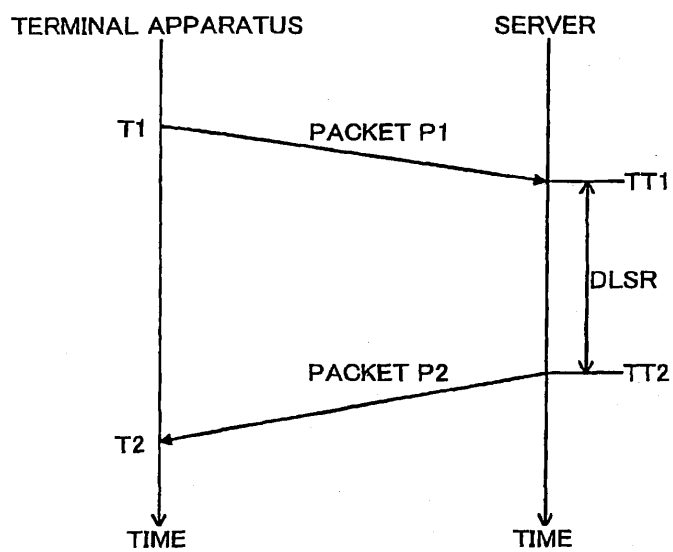


FIG.16

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP01/05831

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                              |                                                                                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| <b>A. CLASSIFICATION OF SUBJECT MATTER</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                              |                                                                                   |
| Int.Cl. <sup>7</sup> H04L 12/56, H04L 29/08, H04L 1/16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                              |                                                                                   |
| According to International Patent Classification (IPC) or to both national classification and IPC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                              |                                                                                   |
| <b>B. FIELDS SEARCHED</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                              |                                                                                   |
| Minimum documentation searched (classification system followed by classification symbols)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                              |                                                                                   |
| Int.Cl. <sup>7</sup> H04L 12/56, H04L 29/08, H04L 1/16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                              |                                                                                   |
| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                              |                                                                                   |
| Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-2001<br>Kokai Jitsuyo Shinan Koho 1971-2001 Jitsuyo Shinan Toroku Koho 1996-2001                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                              |                                                                                   |
| Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                              |                                                                                   |
| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                              |                                                                                   |
| Category*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Citation of document, with indication, where appropriate, of the relevant passages                                                                           | Relevant to claim No.                                                             |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | JP 9-191314 A (Mitsubishi Electric Corporation),<br>22 July, 1997 (22.07.97) (Family: none)                                                                  | 1, 2, 5, 9, 10,<br>16-24                                                          |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Par. Nos. [0022] to [0026], [0035], [0040] to [0042]                                                                                                         | 3, 4, 8, 11-13, 15                                                                |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                              | 6, 7, 14                                                                          |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | JP 2000-69088 A (Nippon Telegr. & Teleph. Corp. <NTT>),<br>03 March, 2000 (03.03.00) (Family: none)                                                          | 3, 4, 8, 11, 12, 15                                                               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Par. Nos. [0009] to [0012]                                                                                                                                   |                                                                                   |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | US 5978335 A (Alan Robert Clark),<br>02 November, 1999 (02.11.99),<br>& JP 10-64174 A & EP 817193 A2<br>& KR 98004472 A<br>Claim 12                          | 13                                                                                |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | JP 3-286644 A (Hitachi, Ltd.),<br>17 December, 1991 (17.12.91) (Family: none)<br>page 5, lower right column, line 19 to page 6, upper left<br>column, line 4 | 6                                                                                 |
| <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                              |                                                                                   |
| * Special categories of cited documents:<br>"A" document defining the general state of the art which is not considered to be of particular relevance<br>"B" earlier document but published on or after the international filing date<br>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)<br>"O" document referring to an oral disclosure, use, exhibition or other means<br>"P" document published prior to the international filing date but later than the priority date claimed<br>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention<br>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone<br>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art<br>"Z" document member of the same patent family |                                                                                                                                                              |                                                                                   |
| Date of the actual completion of the international search<br>19 September, 2001 (19.09.01)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                              | Date of mailing of the international search report<br>02 October, 2001 (02.10.01) |
| Name and mailing address of the ISA/<br>Japanese Patent Office                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                              | Authorized officer                                                                |
| Facsimile No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                              | Telephone No.                                                                     |

Form PCT/ISA/210 (second sheet) (July 1992)

EP 1 225 735 A1

INTERNATIONAL SEARCH REPORT

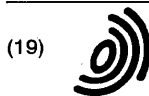
International application No.

PCT/JP01/05831

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                               | Relevant to claim No. |
|-----------|------------------------------------------------------------------------------------------------------------------|-----------------------|
| A         | JP 57-13596 A (NEC Corporation),<br>23 January, 1982 (23.01.82) (Family: none)<br>Claims                         | 7, 14                 |
| A         | JP 10-126771 A (Toshiba Corporation),<br>15 May, 1998 (15.05.98) (Family: none)<br>Par. Nos. [0081] to [0083]    | 1, 19, 22             |
| A         | JP 11-127108 A (Nissan Motor Co., Ltd.),<br>11 May, 1999 (11.05.99) (Family: none)<br>Par. Nos. [0032] to [0039] | 1-24                  |

Form PCT/ISA/210 (continuation of second sheet) (July 1992)



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11) EP 1 246 409 A1

(12)

**EUROPEAN PATENT APPLICATION**  
published in accordance with Art. 158(3) EPC

(43) Date of publication:  
02.10.2002 Bulletin 2002/40

(51) Int Cl.7: H04L 12/56, H04L 1/16,  
H04L 29/08

(21) Application number: 00964680.3

(86) International application number:  
PCT/JP00/06941

(22) Date of filing: 05.10.2000

(87) International publication number:  
WO 02/030067 (11.04.2002 Gazette 2002/15)

(84) Designated Contracting States:  
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE

- TAKATORI, Norihito  
Chiyoda-ku, Tokyo 100-8310 (JP)
- FUKUDA, Kazuma  
Chiyoda-ku, Tokyo 100-8310 (JP)

(71) Applicant: MITSUBISHI DENKI KABUSHIKI  
KAISHA  
Tokyo 100-8310 (JP)

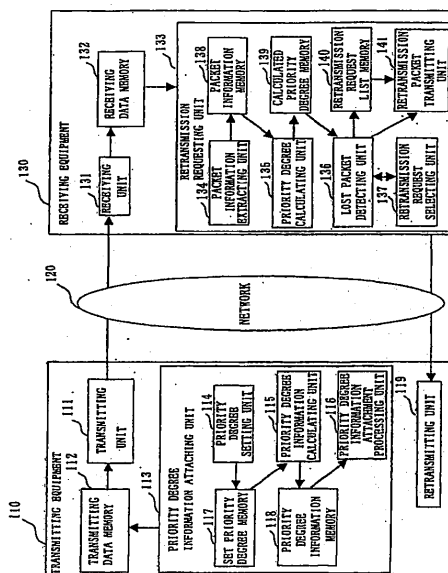
(74) Representative: Pfenning, Meinig & Partner  
Mozartstrasse 17  
80336 München (DE)

(72) Inventors:  
• OKUMURA, Seiji  
Chiyoda-ku, Tokyo 100-8310 (JP)

(54) **PACKET RETRANSMISSION SYSTEM, PACKET TRANSMISSION DEVICE, PACKET  
RECEPTION DEVICE, PACKET RETRANSMISSION METHOD, PACKET TRANSMISSION  
METHOD AND PACKET RECEPTION METHOD**

(57) In a packet retransmitting system for retransmitting a packet including a sequence number in a packet header, which is lost during packet communication, a transmitting equipment (110) includes a priority degree information attaching unit (113) for defining a plurality of priority degrees, setting an importance degree of each of the plurality of priority degrees for a packet, producing priority degree information by using the plurality of priority degrees, and attaching the priority degree information to the packet header included in the packet repeatedly for each of the plurality of packets, a transmitter (111) for transmitting the plurality of packets, and a retransmission unit (119) for receiving a retransmission request packet and retransmitting a packet of which retransmission is requested in the retransmission request packet received. A receiving equipment (130) includes a receiving unit (131) for receiving the plurality of packets and a retransmission requesting unit (133) for extracting a plurality of sequence numbers and a plurality of priority degree information from the packet header, detecting lost packets based on the plurality of sequence numbers and the plurality of priority degree information extracted, detecting an important packet among the lost packets, and requesting retransmission of the packet.

Fig. 1



## Description

## Technical Field

5 [0001] This invention relates to a system and a method of requesting retransmission between a server for distributing data, e.g., multimedia data which have a plurality of priority degrees and a client based on the plurality of priority degrees when a packet is lost.

## Background Art

10 [0002] Generally, a packet transmitted in a network is often lost due to an overflow at a node (router) provided in the network, bit error in a wireless space, etc. In such a case, there is a method in which a receiver requests a transmitter to retransmit a lost packet, and the transmitter who is requested to retransmit retransmits the lost packet.

15 [0003] For example, in a protocol of TCP (Transmission Control Protocol), the receiver transmits an ACK packet to the transmitter for acknowledging receipt. When the ACK packet is not returned to the transmitter, the transmitter judges that the receiver has not received a packet and retransmits the packet. As stated, the TCP protocol is a reliable transfer protocol.

[0004] However, unlike downloading of data, it is not necessary to receive all of data for reproducing the data in streaming distribution in multimedia. Therefore, the receiver can request to retransmit only an important data packet when the packet is lost, and the transmitter can retransmit only the important data packet. Since only the important packet is retransmitted, a band (bandwidth) can be utilized effectively. Further, since the receiver does not wait for the retransmission of an unnecessary data packet, real-time characteristics can be improved.

[0005] A retransmission control system for the above-stated purposes is disclosed in Japanese Unexamined Published Patent Application Hei 9-214507 and Japanese Unexamined Published Patent Application Hei 11-284657.

25 [0006] The retransmitting system disclosed in Japanese Unexamined Published Patent Application Hei 9-214507 uses a wireless communication method for performing real-time communication while guaranteeing a possible best quality. In the wireless communication method, when the packet is lost, the retransmission is tried a few times. If the retransmission does not reach the receiver after trying, a packet in a low priority degree is cancelled, and the retransmission is tried.

30 [0007] A retransmitting system disclosed in Japanese Unexamined Published Patent Application Hei 11-284657 is a retransmission control system in a connection establishing type communication for suppressing communication of a packet in a low priority degree at a time of congestion. In this retransmission control system, a possible number of retransmission to each connection is set, and the possible number of retransmission is reduced by one after retransmission. When the possible number of retransmission becomes zero, communication to the connection is stopped, and a band in a high priority degree is secured as much as possible.

[0008] Further, as a protocol for data transfer with high real-time characteristics, e.g., streaming distribution, RTP (Real-Time Transport Protocol) is a standard related to Internet, e.g., RFC (Request for Comments) 1889. The RTP is a protocol for transmitting a packet to which a sequence number and a timestamp are attached. Some retransmitting systems using the RTP are proposed.

40 [0009] As a method for extending a retransmission function of the RTP, an Internet draft (draft-miyazaki-avt-rtp-select-01.txt) titled "RTP Payload Type Format to Enable Multiple Selective Retransmissions" has been submitted to IETF (Internet Engineering Task Force). In this method for extending the retransmission function written in the Internet draft, there is a second sequence number (SSN: Second Sequence Number) allocated only to an important packet to be retransmitted besides a RTP sequence number. By using the SSN, the receiver can identify the important packet to be retransmitted, and even if the packet is lost, the receiver can request to retransmit only the important packet. In this Internet draft, a RTP header in a RTP packet transferred from the transmitter to the receiver is configured as illustrated in Fig. 16 (201). Fig. 17 (202) illustrates a RTCP (Real-Time Control Protocol) packet for requesting the retransmission, which is transferred from the receiver to the transmitter. In the RTP header illustrated in Fig. 16 (201), the RTP header of the RFC 1889 is extended by 4 bytes, and a SSN field is provided there. The SSN is different from the RTP sequence number. In the SSN, an initial value is zero, and the value is increased by one only for the important packet which should be retransmitted. Further, S is SSNIndicator for indicating that the SSN is increased by one.

45 [0010] Fig. 18 shows a process of specifying a packet of which retransmission is requested based on the SSN included in the RTP header of Fig. 16 (201) by the receiver. As illustrated in Fig. 18, the RTP sequence number is increased by one for every packet (301), but the SSN is increased by one only for each of important packets (302). Further, it is possible to detect a timing when the SSN is increased by one. As stated, the SSN indicates that the packet in which the SSN is increased by one is the important packet which should be retransmitted when the packet is lost.

55 [0011] For example, when the receiver receives a packet of RTP sequence number 15 just after a packet of RTP sequence number 10, packets of RTP sequence numbers 11 - 14 are lost. In this case, the SSN of the packet of RTP



sequence number 10 is 3, and the SSN of the packet of RTP sequence number 15 is 6. Since the SSN is increased from 3 to 6 inconsecutively, it is easy to judge that two important packets of which SSN's are 4 and 5, which should be retransmitted, are lost. Further, since it is judged that the packet of RTP sequence number 15 is not an important packet to be retransmitted based on a S bit in the RTP header (303), an important packet of which SSN is 6 is also lost. Therefore, the receiver transmits values of the SSN's, i.e., 4, 5, and 6, of the packets which should be retransmitted as a retransmission request to the transmitter. The transmitter retransmits an important packet to be transmitted, of which S bit of the RTP header is 1, among the packets of which SSN's are 4, 5 and 6.

**[0012]** As stated, in the retransmission according to the TCP protocol, since a retransmission packet is waited for, it takes time for the retransmission. Further, an excess of the ACK packet and an increase of the retransmission packet pressure a band, and cause congestion. Further, the receiver waits for the retransmission packet and requests the retransmission many times. The receiver is performing a useless retransmission processing.

**[0013]** The retransmitting system of the RTP written in the Internet draft titled "RTP Payload Type Format to Enable Multiple Selective Retransmissions" is a retransmitting system when one priority degree is set. For setting a plurality of priority degrees, a plurality of SSN's is necessary. Consequently, a length of the RTP header becomes longer. In an example of Fig. 18, a combination of the SSN and the S is increased for one RTP sequence number.

#### Disclosure of the Invention

**[0014]** A packet retransmitting system according to this invention for transmitting a packet including a sequence number for defining a sequence of data included in each of a plurality of packets through a network and retransmitting a packet which is lost during transmission includes a transmitting equipment for transmitting the plurality of packets and a receiving equipment for receiving the plurality of packets sent by the transmitting equipment. The transmitting equipment includes a priority degree information attaching unit for defining a plurality of priority degrees indicating an importance degree of the data, producing priority degree information by using the plurality of priority degrees defined, and attaching the priority degree information produced to the packet, a transmitting unit for transmitting a plurality of packets to which the priority degree information is attached by the priority degree information attaching unit through the network, and a retransmitting unit for receiving a retransmission request for requesting to retransmit a packet from the receiving equipment after the transmitting unit transmits the plurality of packets and retransmitting the packet of which retransmission is requested in the retransmission request received. The receiving equipment includes a receiving unit for receiving the plurality of packets sent by the transmitting equipment through the network and a retransmission requesting unit for inputting the plurality of packets received by the receiving unit, extracting a plurality of sequence numbers and a plurality of priority degree information from each of the plurality of packets input, judging lost packets based on the plurality of sequence numbers extracted, detecting an important packet among the lost packets judged based on the plurality of priority degree information extracted, and transmitting the retransmission request to the transmitting equipment to request to retransmit the packet detected.

**[0015]** A transmitting equipment according to this invention for transmitting a packet including a sequence number for defining a sequence of data included in each of a plurality of packets through a network includes a priority degree information attaching unit for defining a plurality of priority degrees indicating an importance degree of the data, producing priority degree information by using the plurality of priority degrees defined, and attaching the priority degree information produced to the packet and a transmitting unit for transmitting the packet to which the priority degree information is attached by the priority degree information attaching unit through the network.

**[0016]** The priority degree information attaching unit includes a priority degree setting unit for setting an importance degree for each of the plurality of priority degrees, a priority degree memory for storing the plurality of priority degrees set by the priority degree setting unit, and a priority degree information calculating unit for producing the priority degree information by using the plurality of priority degrees stored in the priority degree memory and the sequence number included in the packet.

**[0017]** The priority degree setting unit defines the plurality of priority degrees hierarchically by setting an order, and the priority degree information calculating unit calculates the priority degree information by giving priority to a priority degree in a high order.

**[0018]** The priority degree setting unit selects a priority degree one by one from a higher order among the plurality of priority degrees, judges an importance degree of data included in the packet based on the priority degree selected, and increases a value of the priority degree selected by one and sets the value of the priority degree selected when it is judged as an important packet.

**[0019]** The priority degree information calculating unit produces the priority degree information by using a result of adding one of values of the plurality of priority degrees corresponding to the packet to a product of a determined value and the sequence number included in the packet.

**[0020]** When a number of the plurality of priority degrees is defined as PH, a value of the plurality of priority degrees is defined as PL (PH), a counter is defined as N, a sequence number included in the arbitrary packet is defined as SN,

and a value of the priority degree information calculated for each of the plurality of priority degrees is defined as PLD (PH) for an arbitrary packet, the priority degree information calculating unit substitutes PL (0) for PLD (0) and calculates PLD (N) = the determined value  $\times$  SN + PL (N) for each of N in a value of  $0 < N < PH$ , defines PLD (PH - 1) in case of N = PH - 1 as the priority degree information PLD of the arbitrary packet, obtains the priority degree information by calculating PLD (PH - 1) for each of the plurality of packets, and calculates the plurality of priority degree information.

**[0021]** The priority degree information calculating unit uses a value of PLD (N - 1) as the determined value.

**[0022]** The priority degree information calculating unit uses one of (IPLD (N - 1) - PL (N)) which is an absolute value of a difference between PLD (N - 1) and PL (N), (ISN - PLD (N - 1)) which is an absolute value of a difference between SN and PLD (N - 1), and (ISN - PL (N)) which is an absolute value of a difference between SN and PL (N) as the determined value.

**[0023]** The priority degree information calculating unit defines a minimum value among IPLD (N - 1) - PL (N), ISN - PLD (N - 1), ISN - PL (N) as Q, defines an identifier for identifying which value among three values is defined as Q as PQ, defines an identifier for identifying which is larger between X and Y as PD when Q = IX - Y, sets PQ = TYPE1, PD = 0, R = PL (N) in case of Q = IPLD (N - 1) - PL (N) and PLD (N - 1)  $\geq$  PL (N), sets PQ = TYPE1, PD = 1, R = PLD (N - 1) in case of Q = IPLD (N - 1) - PL (N) and PLD (N - 1) < PL (N), sets PQ = TYPE2, PD = 0, R = PL (N) in case of Q = ISN - PLD (N - 1) and SN  $\geq$  PLD (N - 1), sets PQ = TYPE2, PD = 1 in case of Q = ISN - PLD (N - 1) and SN < PLD (N - 1), and sets PQ = TYPE3, PD = 0, R = PLD (N - 1) in case of Q = ISN - PL (N), and calculates PLD (PH - 1). The priority degree information attaching unit attaches PLD (PH - 1), PQ and PD to the packet as the priority degree information.

**[0024]** The transmitting equipment further includes a retransmitting unit for receiving a retransmission request packet for requesting retransmission of a packet after transmitting the plurality of packets from the transmitting unit, retrieving a packet of which retransmission is requested in the retransmission request packet received, and retransmitting the packet retrieved.

**[0025]** A receiving equipment according to this invention includes a receiving unit for receiving a plurality of packets including a sequence number which defines a sequence of data included in each of the plurality of packets and priority degree information produced based on a plurality of priority degrees indicating an importance degree of data included through a network and a retransmission requesting unit for inputting the plurality of packets received by the receiving unit, extracting a plurality of sequence numbers and a plurality of priority degree information from each of the plurality of packets input, judging lost packets based on the plurality of sequence numbers extracted, detecting an important packet among the lost packets judged based on the plurality of priority degree information, and transmitting a retransmission request to request to retransmit the packet detected.

**[0026]** The retransmission requesting unit detects the important packet by using the importance degree indicated in each of the plurality of priority degrees included in the plurality of priority degree information.

**[0027]** The retransmission requesting unit includes a packet information memory for storing the plurality of sequence numbers and the plurality of priority degree information extracted, a priority degree calculating unit for calculating a value of a plurality of priority degrees by using the sequence numbers and the priority degree information stored in the packet information memory, and a lost packet detecting unit for judging a lost packet based on the plurality of sequence numbers and detecting if any important packet is lost based on the value of the plurality of priority degrees calculated by the priority degree calculating unit.

**[0028]** The priority degree calculating unit calculates a quotient and a remainder by dividing the priority degree information by the sequence number, and calculates a value of the plurality of priority degrees by using the quotient and the remainder calculated.

**[0029]** When the priority degree information is defined as PLD, the sequence number included in an arbitrary packet is defined as SN, a number of the plurality of priority degrees is defined as PH, a value of the plurality of priority degrees is defined as PL (PH), and a counter is defined as N for an arbitrary packet, the priority degree information calculating unit substitutes an initial value of N in a range of  $0 \leq N < PH$  for N = PH - 1, substitutes a remainder of PLD / SN for PL (N), substitutes a quotient of PLD / SN for PLD, repeats a calculation of deducting N by 1 till N reaches 0, calculates a value of the plurality of priority degrees by substituting a value of PLD for PL (0) in case of N = 0, calculates PL (PH) for each of the plurality of packets, and calculates the value of the plurality of priority degrees corresponding to the plurality of packets. The lost packet detecting unit judges if a packet with a priority degree indicated by PL (N) is lost based on a difference between values of a maximum value in PL (N) corresponding to each of the plurality of packets received and PL (N) of the arbitrary packet, and when the packet has been lost, detects the PL (N) of the packet.

**[0030]** The priority degree information includes priority degree data produced from the plurality of priority degrees, an identifier for indicating a type of data used for producing the priority degree data, and a flag for indicating a size of a value of the identifier for each of arbitrary packets. When the priority degree data are defined as PLD, the identifier is defined as PQ, the flag is defined as PD, a number of the plurality of priority degrees is defined as PH, a value of the plurality of priority degrees is defined as PL (PH), and a counter is defined as N for an arbitrary packet, the priority degree information calculating unit substitutes an initial value of N in a range of  $0 \leq N < PH$  for N = PH - 1, defines

TYPE1, TYPE2 and TYPE 3 as types of the identifier PQ, defines that a value of the flag PD is one of 0 and 1, defines a quotient Q obtained by dividing PLD by SN as Q and a remainder as R, sets  $PL(N) = R$  and substitutes Q + R for PLD in case of PQ = TYPE1 and PD = 0, sets  $PL(N) = Q + R$  and substitutes R for PLD in case of PQ = TYPE1 and PD = 1, sets  $PL(N) = R$  and substitutes SN - Q for PLD in case of PQ = TYPE2 and PD = 0, sets  $PL(N) = R$  and substitutes Q + SN for PLD in case of PQ = TYPE2 and PD = 1, sets  $PL(N) = SN - Q$  and substitutes R for PLD in case of PQ = TYPE3, repeats a calculation of deducting N by 1 from N = PH - 1 to N = 1, calculates PL from PL (0) to PL (PH - 1) by substituting PLD for PL (0) in case of N = 1. The lost packet detecting unit judges if an important packet in the priority degree N is lost based on a difference between values of a maximum value of PL (N) of a packet and PL (N) of an arbitrary packet among the plurality of packets received by the receiving unit and detects the PL (N) of the packet lost when the packet has been lost.

[0031] The retransmission requesting unit further includes a retransmission request selecting unit for selecting a particular priority degree among the plurality of priority degrees. The lost packet detecting unit detects loss of a packet based on the particular priority degree selected by the retransmission request selecting unit.

[0032] A packet retransmitting method according to this invention for transmitting a packet including a sequence number for defining a sequence of data included in each of a plurality of packets from a transmitter to a receiver through a network and retransmitting a packet which is lost during transmission includes, in the transmitter, defining a plurality of priority degrees indicating an importance degree of data, producing priority degree information by using the plurality of priority degrees defined, attaching the priority degree information produced to the packet, repeating producing the priority degree information and attaching the priority degree information to each of the plurality of packets, and transmitting the plurality of packets to which the priority degree information is attached to the receiver through the network, and in the receiver, receiving the plurality of packets through the network, extracting a plurality of sequence numbers and a plurality of priority degree information from each of the plurality of packets received, judging lost packets based on the plurality of sequence extracted, detecting an important packet among the lost packets judged based on the plurality of priority degree information extracted, and transmitting a retransmission request to the transmitter to request to retransmit the packet detected.

[0033] A packet transmitting method according to this invention for transmitting a packet including a sequence number for defining a sequence of data included in each of a plurality of packets through a network includes defining a plurality of priority degrees indicating an importance degree of the data, producing priority degree information by using the plurality of priority degrees defined, attaching the priority degree information produced to the packet, and transmitting the packet to which the priority degree information is attached through the network.

[0034] The step of defining the priority degrees includes defining the plurality of priority degrees hierarchically by setting an order, selecting a priority degree from a higher priority degree among the plurality of priority degrees, judging an importance degree in the selected priority degree, and adding one to a value of the selected priority degree when it is judged as an important packet. The step of producing the priority degrees information includes producing the priority degree information by using a result of adding a value of one of the plurality of priority degrees corresponding to the packet to a product of a determined value and a sequence number included in the packet.

[0035] The step of defining the priority degrees includes setting values of the plurality of priority degrees corresponding to the plurality of packets by setting a value of the plurality of priority degrees repeatedly for the plurality of packets. The step of producing the priority degree information includes producing the priority degree information corresponding to each of the plurality of packets by producing the priority degree information repeatedly for the plurality of packets.

[0036] A packet receiving method according to this invention includes receiving a plurality of packets including a sequence number for defining a sequence of data included in each of the plurality of packets and priority degree information produced based on a plurality of priority degrees indicating an importance degree of data stored in each of the plurality of packets through a network, extracting a plurality of sequence numbers and a plurality of priority degree information from the plurality of packets received, judging lost packets based on the plurality of sequence numbers extracted, detecting an important packet based on the plurality of priority degree information extracted among the packets judged as the lost packets, and transmitting a retransmission request for requesting to retransmit the packet detected.

## Brief Description of the Drawings

### [0037]

- Fig. 1 illustrates an example of a configuration of a packet retransmitting system according to this invention;
- Fig. 2 illustrates an example of priority degree information and a plurality of priority degrees;
- Fig. 3 illustrates an example of a retransmission request and a method for detecting a retransmission packet;
- Fig. 4 shows a flow chart of an example of operations by a transmitter in Embodiment 1;
- Fig. 5 shows a flow chart of an example of operations by a receiver in Embodiment 1;

Fig. 6 illustrates an example of a configuration of a RTP packet header in Embodiment 1;  
 Fig. 7 illustrates an example of a configuration of a RTCP for requesting the retransmission in Embodiment 1;  
 Fig. 8 shows an example of operations for requesting the retransmission in case of PH = 2 in Embodiment 1;  
 Fig. 9 shows a flow chart for explaining an example of the operations by the transmitter in Embodiment 2;  
 5 Fig. 10 shows a flow chart for explaining an example of a process of subroutine 1 in Embodiment 2;  
 Fig. 11 shows a flow chart for explaining an example of operations by the receiver in Embodiment 2;  
 Fig. 12 shows a flow chart for explaining an example of a process of subroutine 2 in Embodiment 2;  
 Fig. 13 illustrates an example of a configuration of the RTP packet header in Embodiment 2;  
 Fig. 14 illustrates an example of a configuration of the RTCP for requesting the retransmission in Embodiment 2;  
 10 Fig. 15 shows an example of operations for requesting the retransmission in case of PH = 2 in Embodiment 2;  
 Fig. 16 illustrates an example of the RTP packet header according to the related art;  
 Fig. 17 illustrates an example of a configuration of the RTCP packet for requesting the retransmission according to the related art; and  
 Fig. 18 shows an example of a second sequence number SSN and operations for requesting the retransmission according to the related art.

Best Mode for Carrying out the Invention

[0038] Fig. 1 illustrates an example of a configuration of a packet retransmitting system according to this invention.  
 20 [0039] In the specifications, a packet is a packet including a sequence number. In explanation of the following embodiments, the RTP packet is used as an example of the packet including the sequence number. However, the packet is not limited to the RTP packet. The packet retransmitting system according to this invention can be applied to any packet including the sequence number. Further, it is also possible that a packet includes a packet header and the packet header includes a sequence number which defines an arrangement sequence of data included in the packet.  
 25 [0040] In the following explanation, an example of including the packet header is explained.  
 [0041] In the following explanation, a priority degree is a value indicating an importance degree of data included in an arbitrary packet. In this packet retransmitting system, a plurality of priority degrees is set for the arbitrary packet. The plurality of priority degrees is hierarchical, and a priority order is set among the plurality of priority degrees. Priority degree information is information indicating a priority degree of a packet generated based on the plurality of priority degrees. The priority degree information is produced based on the plurality of priority degrees by the transmitter. The receiver receives the priority degree information, and calculates the plurality of priority degrees of the packet based on the received priority degree information.  
 30 [0042] In the following, the configuration of the packet retransmitting system illustrated in Fig. 1 as an example is explained.  
 35 [0043] The packet retransmitting system in Fig. 1 includes a transmitting equipment 110, a network 120 and a receiving equipment 130.  
 [0044] The network 120 can be either wireless or wired, and it can be any communication network as far as the packet can be transmitted in the network.  
 [0045] The transmitting equipment 110 includes a transmitting unit 111, a transmitting data memory 112, a priority degree information attaching unit 113 and a retransmitting unit 119.  
 40 [0046] The transmitting unit 111 transmits a packet at a specified time.  
 [0047] The transmitting data memory 112 stores a plurality of packets sent by the transmitting unit 111.  
 [0048] The priority degree information attaching unit 113 defines a plurality of priority degrees. The priority degree information attaching unit 113 sets an importance degree of each of the plurality of priority degrees defined, produces priority degree information by using the plurality of priority degrees, and attaches the produced priority degree information to the packet header included in the packet. The priority degree information attaching unit 113 sets the importance degree, produces the priority degree information, and attaches the priority degree information to the packet header for each of a plurality of packets which are sent.  
 45 [0049] After the transmitting equipment 110 transmits the plurality of packets, the retransmitting unit 119 receives a retransmission request packet for requesting retransmission of a packet, retrieves a packet of which retransmission is requested in the received retransmission request packet, and retransmits the retrieved packet.  
 50 [0050] The priority degree information attaching unit 113 includes a priority degree setting unit 114, a priority degree information calculating unit 115, a priority degree information attachment processing unit 116, a set priority degree memory 117, and a priority degree information memory 118.  
 55 [0051] The priority degree setting unit 114 sets the importance degree (value of the priority degree) for each of the plurality of priority degrees.  
 [0052] The set priority degree memory 117 stores the plurality of priority degrees set by the priority degree setting unit 114.

[0053] The priority degree information calculating unit 115 produces the priority degree information by using the plurality of priority degrees stored in the set priority degree memory 117 and the sequence number included in the packet header.

[0054] The priority degree information memory 118 stores the priority degree information produced by the priority degree information-calculating unit 115.

[0055] The priority degree information attachment processing unit 116 attaches the priority degree information produced by the priority degree information calculating unit 115 and stored in the priority degree information memory 118 to the packet header included in the packet.

[0056] It is also possible that the set priority degree memory 117 uses a storage area in the priority degree setting unit 114 and outputs the plurality of priority degrees set by the priority degree setting unit 114 to the priority degree information calculating unit 115 directly. Further, it is also possible that the priority degree information memory 118 uses a storage area in the priority degree information calculating unit 115, uses the storage area in the priority degree information calculating unit 115 and outputs the priority degree information produced by the priority degree information calculating unit 115 to the priority degree information attachment processing unit 116 directly. Further, the set priority degree memory 117 and the priority degree information memory 118 can be realized as one memory.

[0057] Next, the receiving equipment 130 is explained.

[0058] The receiving equipment 130 includes a receiving unit 131, a receiving data memory 132 and a retransmission requesting unit 133.

[0059] The receiving unit 131 receives the plurality of packets sent from the transmitting equipment 110 through the network 120.

[0060] The receiving data memory 132 stores the packets received by the receiving unit 131.

[0061] The retransmission requesting unit 133 inputs the plurality of packets received by the receiver 131, extracts a plurality of sequence numbers and a plurality of priority degree information from packet headers included in the plurality of input packets respectively, judges lost packets based on the plurality of extracted sequence numbers, detects an important packet among the lost packets based on the plurality of priority degree information, and requests retransmission of the detected packet.

[0062] The retransmission requesting unit 133 includes a packet information extracting unit 134, a priority degree calculating unit 135, a lost packet detecting unit 136, a retransmission request selecting unit 137, a packet information memory 138, a calculated priority degree memory 139, a retransmission request list memory 140 and a retransmission packet transmitting unit 141.

[0063] The packet information extracting unit 134 reads the plurality of packets received by the receiving unit 131 and stored in the receiving data memory 132, and extracts the plurality of sequence numbers and the plurality of priority degree information from the packet headers included in the plurality of read packets respectively.

[0064] The packet information memory 138 stores the plurality of sequence numbers and the plurality of priority degree information extracted by the packet information extracting unit 134.

[0065] The priority degree calculating unit 135 calculates a plurality of priority degrees from the sequence numbers and the priority degree information stored in the packet information memory 138.

[0066] The calculated priority degree memory 139 stores the plurality of priority degrees calculated by the priority degree calculating unit 135.

[0067] The lost packet detecting unit 136 reads the plurality of priority degree information calculated by the priority degree calculating unit 135 and stored in the calculated priority degree memory 139, detects the lost packets based on the plurality of sequence numbers, judges if any important packet is lost for each of the plurality of priority degrees based on the plurality of priority degrees calculated by the priority degree calculating unit, and detects loss of the important packet. The lost packet detecting unit 136 treats the detected packet as the retransmission request packet for requesting the retransmission and creates a retransmission request list.

[0068] The retransmission request selecting unit 137 selects a particular priority degree among the plurality of priority degrees, and notifies the lost packet detecting unit 136 of the selected priority degree.

[0069] The retransmission request list memory 140 stores the retransmission request list created by the lost packet detecting unit 136.

[0070] The retransmission packet transmitting unit 141 transmits the retransmission request packet to the transmitting equipment 110 based on the retransmission request list stored in the retransmission request list memory 140.

[0071] Further, it is also possible that the calculated priority degree memory 139 uses a storage area in the priority degree calculating unit 135 and outputs the plurality of priority degrees calculated by the priority degree calculating unit 135 to the lost packet detecting unit 136 directly. It is also possible that the packet information memory 138, the calculated priority degree memory 139 and the retransmission request list memory 140 are configured either as one memory or a plurality of memories.

[0072] With reference to Fig. 2, an example of a configuration of the RTP sequence numbers and the priority degrees in the packet retransmitting system including the plurality of priority degrees is explained.

[0073] In Fig. 2, 402 is stored in the priority degree information memory 118, and 403 ~ 407 are stored in the set priority degree memory 117.

[0074] A number of the priority degrees is set as priority degree hierarchy (PH). A priority degree in an arbitrary priority degree hierarchy (PH) is set as a priority degree N, and a sequence number (value indicating an importance degree) of the priority degree N is set as PL (N). A range of N is  $0 \leq N \leq PH - 1$ . When N is smaller, the priority degree is higher. Stated setting is performed by the priority degree setting unit 114.

[0075] For example, an important packet to be retransmitted identified by PL (0) has a higher priority degree than an important packet to be retransmitted identified by other PL (1) ~ PL (PH - 1).

[0076] Further, the RTP sequence number (first sequence number) of each of the packets is set as SN, and priority degree data included in the priority degree information is set as PLD. The plurality of packets are indicated as packet i ( $i = 0, 1, 2, \dots, k, \dots$ ). PLD, PL (N) and SN of the i-th packet are set as PLDi, PLi (N) and SNi respectively.

[0077] The PL (N) is same as a case when there is a plurality of second sequence numbers SSN's defined in the Internet draft titled "RTP Payload Type Format to Enable Multiple Selective Retransmissions" according to the related art. The PL (N) is a sequence number increased by one for each of important packets to be retransmitted in the priority degree N, and it is a value indicating an importance degree of the priority degree N. The important packet to be retransmitted is the packet which should be transferred again when the packet transferred from the transmitter to the receiver is lost. Therefore, if the PL (N) of the RTP packet received now by the receiver is larger than the PL (N) of a packet received previously by one, the packet received now can be identified as the important packet to be retransmitted in the priority degree N.

[0078] Further, in the packet retransmitting system according to this invention, even when the plurality of priority degrees ( $PH > 1$ ) is provided for the RTP, the transmitter can attach one of PLD to the packet header instead of attaching N number of PL's to the packet header as in the system according to the related art. The receiver can recognize values of the plurality of priority degrees (importance degrees) (PL) by the one of PLD attached, and request retransmission only for a priority degree N (hierarchy of priority degrees) which is appropriate for a network condition. For example, when a network condition is bad, a band necessary for the retransmission should be reduced. Therefore, the retransmission is requested only for (P\_Level - 1) number of the priority degrees, i.e.,  $N=0, 1, 2, \dots, P\_Level$  ( $P\_Level < PH - 1$ ), which are higher priority degrees, instead of all the priority degrees ( $0 \leq N \leq PH - 1$ ). Further, when all the priority degrees are used, P\_Level is PH - 1.

[0079] Further, it is assumed that the important packets to be retransmitted do not exist simultaneously in the plurality of priority degrees. When the packet of PLi (N) is the important packet to be retransmitted (i.e., PLi (N) is increased by one from the PLi - 1 (N)), there is no important packet to be retransmitted in the priority degrees higher than N.

[0080] In an upper part of Fig. 3, an example of the plurality of priority degrees stored in the set priority degree memory 117 and a process for detecting the retransmission packet is illustrated. For example, in Fig. 3, in a priority degree 0, PL (0) is increased by one from 3 to 4 for a packet of sequence number 6. This shows that the packet of sequence number 6 is the important packet to be retransmitted in the priority degree 0. In this case, in a priority-degree 1, PL (1) is not increased. Therefore, it is not the important packet to be retransmitted in the priority degree 1. Further, when a packet is an important packet to be retransmitted in a priority degree N, the priority degree N is set as a priority degree display S ( $S = N$ ), S for the packet i ( $i = 0, 1, 2, \dots, k, \dots$ ) is set as Si. An initial value of Si is -1. This shows that the packet i with Si = -1 is not the important packet to be retransmitted in all the priority degrees.

[0081] The packet retransmitting system according to this invention can be also adapted to a transmission-protocol including the sequence number besides the RTP packet.

[0082] In the following, the priority degree is explained.

[0083] The priority degree setting unit 114 defines the plurality of priority degrees hierarchically by setting an order.

[0084] Further, the priority degree setting unit 114 selects a priority degree from a higher order sequentially among the plurality of priority degrees for a packet, and judges an importance degree of the packet concerning on the selected priority degree. If it is judged that the packet is an important packet, one is added to a value of the selected priority degree. This is repeated for each of the plurality of priority degrees, and values of the plurality of priority degrees are set. The priority degree setting unit 114 repeatedly sets the values of the plurality of priority degrees as stated for each of the plurality of packets which are sent, and sets the values of the plurality of priority degrees corresponding to each of the plurality of packets.

[0085] Next, the priority degree information is explained.

[0086] A procedure of calculating PLD for an arbitrary packet by the priority degree information calculating unit 115 is explained when a number of the plurality of priority degrees is defined as PH, a value of the plurality of priority degrees is defined as PL (PH), a counter is defined as N, a sequence number included in a packet header of the arbitrary packet is defined as SN, and the priority degree data calculated for each of the plurality of priority degrees are defined as PLD (PH).

[0087] The priority degree information calculating unit 115 substitutes PL (0) for PLD (0), and calculates  $PLD (N) = \text{determined value} \times SN + PL (N)$  for each of N in a value of  $0 < N < PH$ .  $PLD (PH - 1)$  in case of  $N = PH - 1$  is set as

the priority degree data PLD of the arbitrary packet.

[0088] In Embodiment 1, a case of using a value of PLD (N - 1) as the determined value is explained.

[0089] In Embodiment 2, as the determined value, a minimum value among (IPLD (N - 1) - PL (N)) which is an absolute value of a difference between PLD (N - 1) and PL (N), (ISN - PLD (N - 1)) which is an absolute value of a difference between SN and PLD (N - 1), and (ISN - PL (N)) which is an absolute value of a difference between SN and PL (N) is used.

[0090] In the following, a case in which the priority degree data PLD are included in the priority degree information is explained. In Embodiment 2, a case in which other data, e.g., identifier, etc. are included in the priority degree information in addition to the priority degree data PLD is explained. Further, in the following explanation, the priority degree data can be also called as the priority degree information unless clearly stated.

[0091] In the following, actual operations by the transmitter and the receiver are explained.

Embodiment 1.

[0092] In this embodiment, an example in case of PH = 2 is explained.

[0093] Fig. 4 shows a flow chart of an example of the operations by the transmitter in Embodiment 1. Fig. 5 shows a flow chart of an example of the operations by the receiver in Embodiment 1.

[0094] This shows a sequence of a packet which is being processed among packets to be sent.

[0095] The transmitter calculates PLDi (PLD of the i-th packet) from the packet with i = 0, and transmits the packet. At first, when the transmitter receives the retransmission request packet (Yes in 603), the retransmitting unit 119 retransmits the packet of which retransmission is requested (604). In the retransmission request packet, PL of each of priority degrees, which is desired to be retransmitted, is written. For example, information of requesting a packet with PL (0) = 5, 6 and PL (1) = 4 is written in the retransmission request packet. The retransmission request packet can be in any configuration as far as the PL for requesting the retransmission is written. Fig. 7 (802) illustrates an example of the RTCP packet for requesting the retransmission with PH = 2. However, since there is a possibility that there are a plurality of packets with an equal PL, the retransmitting unit 119 is not able to identify the important packet to be retransmitted only by the PL. Therefore, the retransmitting unit 119 retrieves a sequence number of the packet of which retransmission is requested based on two values of the PL and the priority degree display S of each of the packets. A priority degree display Si of a packet shows that packet i is an important packet to be retransmitted in the priority degree display Si.

[0096] A lower part of Fig. 3 illustrates an example of detecting the retransmission packet based on the retransmission request packet by the retransmitting unit 119 in the transmitter.

[0097] In this example, the retransmission request packet requests retransmission of a packet with PL (0) = 5, 6 and PL (1) = 4 (506). In this case, the retransmitting unit 119 detects a packet of sequence number 13 (508) with PL (0) = 5 and S = 0, a packet of sequence number 14 (509) with PL (0) = 6 and S = 0, and a packet of sequence number 12 (507) with PL (1) = 4 and S = 1 as packets to be retransmitted.

[0098] When the retransmission request packet is not received (No in 603), the priority degree setting unit 114 calculates all PL's of the packet i. The priority degree setting unit 114 calculates PL's from the priority degree 0 in a higher order to priority degree PH - 1 sequentially among the plurality of priority degrees. An order among the plurality of priority degrees is indicated as j, and j is a value in a range of  $0 \leq j < PH$ . An initial value of j is 0. S indicates a timing when 1 is added to the PL, and an initial value of S is -1 (605).

[0099] If the packet i is an important packet to be retransmitted in the priority degree j (606), the priority degree setting unit 114 adds one to PLi (j), and sets Si = j (607). If the packet i is important in a priority degree in a certain order, the packet i is not important in a priority degree in another order. Therefore, remaining PLi is set to be equal to PLi - 1 (608). When the packet i is not important in the priority degree j (606), the priority degree setting unit 114 sets PLi (j) = PLi - 1 (j) (610), and the processing goes to a priority degree in a next order (j++) (611).

[0100] The priority degree setting unit 114 performs this processing for all of the plurality of priority degrees, and calculates all of PLi (j) corresponding to the packet i. The priority degree setting unit 114 repeats steps of 606 ~ 612 PH times. The PL set by the priority degree setting unit 114 is stored in the set priority degree memory 117.

[0101] Then, the priority degree information calculating unit 115 calculates PLDi from PLi. A general equation for obtaining the PLDi is as follows:

$$PLDi(0) = PLi(0) \quad (614)$$

$$PLDi(j) = PLDi(j-1) \times Sni + PLi(j)$$

$$1 \leq j \leq PH - 1 \quad (615, 616, 617)$$

- [0102] The priority degree information calculating unit 115 obtains  $PLDi = PLDi \cdot (PH - 1)$  in calculating by using this general equation.
- [0103] The priority degree information attachment processing unit 116 attaches the  $PLDi$  calculated in this way and the  $Si$  to the packet header, and transmits at a time of time stamp of the packet  $i$ .
- 5 [0104] Fig. 6 (801) illustrates an example of attaching the  $PLDi$  and  $Si$  to the RTP header.
- [0105] As a configuration of the packet header, as far as  $PLDi$  and  $Si$  are attached, another configuration besides the configuration of Fig. 6 (801) is possible.
- [0106] Then,  $i$  is incremented, and a same processing is repeated for a next packet. The same processing is performed for all of the plurality of transmitting packets.
- 10 [0107] With reference to Fig. 5, the operations by the receiver are explained.
- [0108] In the receiver, the priority degree information attaching unit 113 obtains priority degree hierarchy  $PH$  of the packet which is sent to the receiver (702). As a method for obtaining, there is a method for notifying a value of  $PH$  from the transmitter in advance before starting transmission of the packet.
- [0109] When the priority degree information attaching unit 113 receives the packet (704), the packet information extracting unit 134 extracts the sequence number  $SN$ , priority degree display  $S$ , and priority degree data  $PLD$  as the priority degree information from the received packet (705). The extracted sequence number  $SN$ , priority degree display  $S$ , and priority degree data  $PLD$  are stored in the packet information memory 138.
- 15 [0110] Then, the priority degree calculating unit 135 calculates each  $PL$  from the  $PLD$ .
- [0111] At first, the priority degree calculating unit 135 sets  $j = PH - 1$  (706). Then, the priority degree calculating unit 135 substitutes a quotient obtained by dividing  $PLD$  with  $SN$  for the  $PLD$ , and substitutes a remainder for  $PL(j)$  (707). The priority degree calculating unit 135 reduces  $j$  by one sequentially, and performs the same processing. Accordingly, all the  $PL$ 's can be obtained (708, 709). The priority degree calculating unit 135 stores the calculated  $PL$ 's in the calculated priority degree memory 139.
- 20 [0112] Then, the retransmission request selecting unit 137 selects a priority degree level  $P\_Level$  ( $0 \leq P\_Level \leq PH - 1$ ) showing a range of orders of the priority degrees for requesting retransmission, and notifies the lost packet detecting unit 136 (711). The priority degree level  $P\_Level$  is indicated in an order of the priority degree. For example, when a network condition is bad, a value becomes lower (a priority degree in a higher order is used). When the network condition is good, the value becomes higher (a priority degree in a lower order is used). The priority degree level  $P\_Level$  does not only depend on the network condition. The priority degree can be set freely.  $P\_Level = PH - 1$  is a value when all the priority degrees are used.
- 30 [0113] Then, the lost packet detecting unit 136 detects loss of an important packet to be retransmitted. Since detection is started from the priority degree 0 which is the highest order, the priority degree  $j = 0$  (712). If  $j$  is larger than the priority degree level  $P\_Level$  (713), the lost packet detecting unit 136 requests to retransmit the important packet to be retransmitted which is lost in the priority degree  $j$  (721).
- 35 [0114] When a value of deducting  $PL(j)\_MAX$  (a maximum value of  $PL(j)$  among the packets which have been received) from  $PL(j)$  is 0, the lost packet detecting unit 136 judges that there is a possibility that a packet is lost, however the important packet to be retransmitted is not lost in the priority degree  $j$ . Therefore, the lost packet detecting unit 136 does not detect packet loss, and goes to a processing for a next priority degree. However, when a value of deducting  $PL(j)\_MAX$  from  $PL(j)$  is larger than 0 (714), the lost packet detecting unit 136 can judge that there is a possibility that the important packet to be retransmitted is lost in the priority degree  $j$ .
- 40 [0115] In this case, if  $S$  is equal to  $j$  (715), a packet which is received now is the important packet to be retransmitted in the priority degree  $j$ . Therefore, the lost packet detecting unit 136 can know that the packet of  $PL(j)$  is not lost. In this case, if a value of deducting  $PL(j)\_MAX$  from  $PL(j)$  is 1 (717), the important packet to be retransmitted is not lost in the priority degree  $j$ . Therefore, the lost packet detecting unit 136 substitutes  $PL(j)$  for  $PL(j)\_MAX$  (719). However, if the value of deducting  $PL(j)\_MAX$  from  $PL(j)$  is larger than one (717),  $PL$  from  $PL(j)\_MAX$  to  $PL(j) - 1$  is lost. Therefore, the lost packet detecting unit 136 adds the lost  $PL$  to the retransmission request list  $j$  (718).
- 45 [0116] Similarly, when  $S$  is not equal to  $j$  (715),  $PL$  from  $PL(j)\_MAX$  to  $PL(j)$  is lost. Therefore, the lost packet detecting unit 136 adds the lost  $PL$  to the retransmission request list  $j$  (718).
- [0117] Then, by setting  $PL(j)\_MAX = PL(j)$ ,  $j++$  (719, 720), processing is continued for a next priority degree.
- 50 [0118] When  $j$  is larger than the priority degree level  $P\_Level$  (713), i.e., the priority degree for checking the loss exceeds the priority degree level, the lost packet detecting unit 136 instructs the retransmission packet transmitting unit 141 to request the transmitter to retransmit the  $PL$  maintained in the retransmission request list (721). The retransmission packet transmitting unit 141 transmits the retransmission request packet to the transmitter. Then, the lost packet detecting unit 136 clears the retransmission request list (722). In the receiving equipment 130, when the packet is continued to be received, the receiving unit 131 receives a new packet, and the retransmission requesting unit 133 performs a similar processing (719). When there is no  $PL$  maintained in the retransmission request list, the retransmission is not requested.
- 55 [0119] Fig. 8 illustrates an example of identification of  $PL(N)$  by the receiver and the retransmission request in case



of PH = 2 in this embodiment.

[0120] In Fig. 8, 901 ~ 905 show that sequence numbers (PL (0) (902) and PL (1) (904)) in two priority degrees must be attached to the packet header when two priority degrees are set in a system according to the related art. 906 ~ 908 show an example in which priority degree data PLD (907) are attached to the packet header as one of the priority degree information when two priority degrees are set in the packet retransmitting system of this embodiment.

[0121] With reference to Fig. 8, a method for requesting retransmission of a lost packet based on the processing by the receiver of this embodiment is explained.

[0122] We assume that packets of sequence numbers 11 - 14 are lost. Since the PLD of sequence number 10 is 43,  $PL_{10}(0)$  is a quotient obtained by dividing 43 by 10, and  $PL_{10}(1)$  is a remainder obtained by dividing 43 by 10. Therefore,  $PL_{10}(0) = 4$ ,  $PL_{10}(1) = 3$  (909). Similarly, since the PLD of sequence number 15 is 94,  $PL_{15}(0)$  is a quotient obtained by dividing 94 by 15, and  $PL_{15}(1)$  is a remainder obtained by dividing 94 by 15. Therefore,  $PL_{15}(0) = 6$ ,  $PL_{15}(1) = 4$  (910). Further, since the priority degree display S of sequence number 15 is -1, the packet of sequence number 15 is not an important packet to be retransmitted in the priority degree 0 and the priority degree 1. Accordingly, the lost packet detecting unit 136 detects that  $PL_{10}(0) - PL_{15}(0)$ , i.e., PL (0) of 5 and 6, are lost in the priority degree 0, and  $PL_{10}(1) - PL_{15}(1)$ , i.e., PL (1) of 4, are lost in the priority degree 1 (911). The retransmission packet transmitting unit 141 transmits a retransmission request packet for requesting to retransmit these PL's to the transmitter (912).

[0123] When a value of the priority degree data PLD becomes larger, it becomes impossible to display the value in a register allocated to the PLD. In such a case, a plurality of priority degrees are initialized, and the priority degrees are set again.

[0124] Further, each of elements in the transmitting equipment 110 and the receiving equipment 130 illustrated in Fig. 1 can be realized as any one of hardware, firmware, and software.

#### Embodiment 2.

[0125] In Embodiment 2, a case of calculating the priority degree data so that the value of the PLD becomes smaller than Embodiment 1 is explained.

[0126] In the receiver, the priority degree data PLD are treated as  $PLD = SN \times Q + R$ . Q is a quotient of  $PLD / SN$ , and R is a remainder of 3. Values of Q and R are also set smaller for each of the packets.

[0127] In the following explanation, explanations are made by using an equation of  $PLD = SN \times Q + R$ .

[0128] At first, setting of the value of Q is explained. Variables A, B and C calculated in the following equation are defined.

[0129]  $A = |PLD(N - 1) - PL(N)|$ ,  $B = |ISN - PLD(N - 1)|$ ,  $C = |ISN - PL(N)|$ , and a minimum value among A, B and C is defined as Q. Further, an identifier PQ for identifying which value among three values is defined as Q; and displayed in 2 bits for example.

[0130] In case of  $Q = PL(0)$ , i.e., same as Embodiment 1,  $PQ = 00$ .

[0131] In case of  $Q = A$ ,  $PQ = 01$ .

[0132] In case of  $Q = B$ ,  $PQ = 10$ .

[0133] In case of  $Q = C$ ,  $PQ = 11$ .

[0134] Further, since A, B and C are absolute values of difference between two values, indicated as  $|X - Y|$ , an identifier (flag) PD for indicating which one of X and Y is larger is defined, and displayed in 1 bit length as follows:

[0135] In case of  $X \geq Y$ ,  $PD = 0$ .

[0136] In case of  $X < Y$ ,  $PD = 1$ .

[0137] In this embodiment, a case in which the priority degree information includes the priority degree data PLD, the identifier PQ and the identifier (flag) PD is explained.

[0138] Fig. 9 and Fig. 10 are flow charts of the transmitter in Embodiment 2 of this retransmitting system. Fig. 11 and Fig. 12 are flow charts of the receiver.

[0139] The transmitting equipment 110 in the transmitter calculates  $PLDi$  from the packet of  $i = 0$ , and transmits the packet. At first, when the transmitter receives the retransmission request packet (Yes in 1003), the retransmitting unit 119 retransmits the packet of which retransmission is requested (1004). In the retransmission request packet, PL of each of the priority degrees desired to be retransmitted is written. The retransmission request packet and the retransmission packet are retrieved in a same method with Embodiment 1.

[0140] Next, the priority degree setting unit 114 calculates all of PL's of the packet i. The priority degree setting unit 114 calculates the PL's from the priority degree 0 in a higher order to priority degree PH - 1 sequentially among the plurality of priority degrees. A method for calculating the PL's is same as Embodiment 1.

[0141] Next, the priority degree information calculating unit 115 calculates  $PLDi$  by using PLi. The priority degree information calculating unit 115 calculates by using the equation ( $PLD = Q \times SN + R$ ) explained in the above. In Embodiment 2, the priority degree information calculating unit 115 sets the values of Q and R smaller so that the value of the PLD becomes further smaller.

# EP 1 246 409 A1

**[0142]** An order among the plurality of priority degrees is indicated as  $j$ , and  $j$  is a value in a range of  $1 \leq j < PH - 1$ . A general equation for obtaining the PLDi is as follows:

$$PLDi(0) = PLi(0) \quad (1014)$$

$$PLDi(j) = IPLDi(j-1) - PLi(j) \times Sni + PLi(j) \quad \text{equation 1 (1107)}$$

$$PLDi(j) = IPLDi(j-1) - PLi(j) \times Sni + PLi(j-1) \quad \text{equation 2 (1109)}$$

$$PLDi(j) = ISNi - PLDi(j-1) \times Sni + PLi(j) \quad \text{equation 3 (1113)}$$

$$PLDi(j) = ISNi - PLi(j) \times Sni + PLDi(j-1) \quad \text{equation 4 (1117)}$$

$$1 \leq j \leq PH - 1$$

**[0143]** The priority degree information calculating unit 115 selects an equation to get a smaller PLDi ( $j$ ) for each of the priority degrees  $j$  among equations 1 - 4 for obtaining PLDi. From this general equation, it can be obtained by PLDi = PLDi (PH - 1).

**[0144]** Therefore, the priority degree information calculating unit 115 sets PLDi (0) = PLi (0) as an initial value (1014). PLDi (0) is for the priority degree 0. Next, the priority degree information calculating unit 115 obtains the PLDi by applying each of the priority degrees to equations 1 - 4 from the priority degree 1. The priority degree information calculating unit 115 sets the priority degree  $j$  to 1 (1015).

**[0145]** Next, the priority degree information calculating unit 115 calculates the PLD by using the subroutine 1 (1016). At first, a judgement is made on if  $X$  is calculated or  $X$  is used without calculation as in Embodiment 1 (1102). The priority degree information calculating unit 115 selects a minimum value among three values of  $IPLDi(j-1) - PLi(j)$ ,  $ISNi - PLDi(j-1)$ , and  $ISNi - PLi(j)$  corresponding to quotients ( $Q$ ) of equations 1 - 4 (1103). The selected value is defined as  $Q$ , and an identifier for identifying the value of  $Q$  is defined as  $PQ$  as stated earlier.

**[0146]** Further, in case of  $PQ = 01$  (1104), a judgement is made on which value is larger between PLDi ( $j-1$ ) and PLi ( $j$ ). The identifier for identifying is defined as  $PD$  as stated earlier. Therefore,  $PD$  is as follows:

In case of  $PLDi(j-1) \geq PLi(j)$ ,  $PD = 0$  (1106)

In case of  $PLDi(j-1) < PLi(j)$ ,  $PD = 1$  (1108)

**[0147]** Similarly, in case of  $PQ = 10$  (1110), a judgement is made on which is a larger value between  $Sni$  and PLDi ( $j-1$ ).  $PD$  is as follows:

In case of  $Sni \geq PLDi(j-1)$ ,  $PD = 0$  (1112).

In case of  $Sni < PLDi(j-1)$ ,  $PD = 1$  (1114).

**[0148]** In case of  $PQ = 11$  (1115), always  $Sni \geq PLi(j)$ . Therefore,  $PD = 0$  (1116).

**[0149]** In case of  $PQ = 01$ ,  $PD = 0$ , equation 1 is selected. In case of  $PQ = 01$ ,  $PD = 1$ , equation 2 is selected. In case of  $PQ = 10$ , equation 3 is selected. In case of  $PQ = 11$ , equation 4 is selected, and the PLDi is obtained.

**[0150]** When the PLDi is obtained in a method for using  $X$  without calculation as in Embodiment 1 (No in 1102),  $PQ = 00$ ,  $PD = 0$  (1118, 1119). The PLDi is obtained by using an equation of  $PLDi(j) = PLDi(j-1) \times Sni + PLi(j)$  (1120). In this way, the PLD is calculated through a procedure of the subroutine 1 (1016).

**[0151]** Next, the  $PQ$  and  $PD$  are bit-shifted (1017), the priority degree  $j$  is incremented ( $j+1$ ) (1018), and PLDi ( $j$ ) in

a next priority degree is obtained. In a range with  $j$  smaller than  $PH$ , this processing is repeated (1019). A last PLDI ( $PH - 1$ ) is a PLDI corresponding to the packet  $i$ .

[0152] The priority degree information attachment processing unit 116 attaches the  $SI$ , PLDI,  $PQ$  and  $PD$  calculated in this way to the header. The transmitting unit 111 transmits at a time of a time stamp included in the packet header of the packet  $i$  (1020).

[0153] Fig. 13 (1402) illustrates an example of attaching the PLDI and  $SI$  to the RTP header.

[0154] A configuration of the header is not limited to a configuration of Fig. 13 (1402). As far as the  $SI$ , PLDI,  $PQ$  and  $PD$  are attached, another configuration is possible.

[0155] Next,  $i$  is incremented ( $i++$ ), and a similar processing is performed for a next packet (1021, 1022).

[0156] Next, with reference to Fig. 11 and Fig. 12, operations of the receiver are explained.

[0157] In the receiver, the retransmission requesting unit 133 obtains a priority degree hierarchy  $PH$  of a packet which is sent (1202). As a method for obtaining, there is a method for informing of a value of the  $PH$  from the transmitter in advance before starting transmission of the packet for example.

[0158] When the receiving unit 131 receives the packet (1204), the packet information extracting unit 134 extracts the sequence number  $SN$ , priority degree display  $S$ , identifier  $PQ$ , identifier  $PD$  and priority degree data  $PLD$  from the packet header of the received packet (1205). The extracted sequence number  $SN$ , priority degree display  $S$ , identifier  $PQ$ , identifier  $PD$  and priority degree data  $PLD$  are stored in the packet information memory 138.

[0159] Next, the priority degree calculating unit 135 calculates each of  $PL$ 's from the  $PLD$ . At first, the priority degree calculating unit 135 sets  $j = PH - 1$ , substitutes a quotient obtained by dividing  $PLD(j)$  by  $SN$  for  $Q(j)$ , and substitutes a remainder for  $R(j)$  (1305). Then, the priority degree calculating unit 135 calculates all  $PL$ 's from the  $PLD$ ,  $PQ$  and  $PD$  through a procedure of subroutine 2 (Fig. 12) (1206). Then,  $PQ$  of the priority degree  $j$  is substituted for  $PQ(j)$ , the  $PQ$  is bit-shifted and  $PQ(j)$  is obtained (1304).

[0160] Next, the priority degree calculating unit 135 obtains  $PL(j)$  through a following processing.

[0161] In case of  $PQ(j) = 01$  and  $PD(j) = 0$ ,  $PL(j) = R$ , and  $PLD(j - 1) = Q + R$  (1308, 1309).

[0162] In case of  $PQ(j) = 01$  and  $PD(j) = 1$ ,  $PL(j) = Q + R$ , and  $PLD(j - 1) = R$  (1310, 1311).

[0163] In case of  $PQ(j) = 10$  and  $PD(j) = 0$ ,  $PL(j) = R$ , and  $PLD(j - 1) = SN - Q$  (1313, 1314).

[0164] In case of  $PQ(j) = 10$  and  $PD(j) = 1$ ,  $PL(j) = R$ , and  $PLD(j - 1) = Q + SN$  (1315, 1316).

[0165] In case of  $PQ(j) = 11$ ,  $PL(j) = SN - Q$ , and  $PLD(j - 1) = R$  (1317, 1318).

[0166] In case of  $PQ(j) = 00$ ,  $PL(j) = R$ , and  $PLD(j - 1) = Q$  (1319, 1320).

[0167] By reducing  $j$  one by one and performing this processing (1322), all  $PL$ 's can be obtained. In case of  $j = 0$ ,  $PD(0) = PLD(0)$  (1323). The priority degree calculating unit 135 stores the priority degrees  $PL$  calculated in the above procedure in the calculated priority degree memory 139.

[0168] Next, the retransmission request selecting unit 137 selects a priority degree level  $P\_Level$  indicating a range of orders of the priority degrees for requesting the retransmission, and informs the lost packet detecting unit 136 (1209). The priority degree level  $P\_Level$  is same as the one explained in Embodiment 1.

[0169] Next, the lost packet detecting unit 136 detects loss of an important packet to be retransmitted. The retransmission packet transmitting unit 141 requests retransmission of the detected packet. A method for detecting the loss of the packet and requesting the retransmission is same as Embodiment 1.

[0170] Fig. 15 illustrates an example of identification of  $PL(N)$  by the receiver and the retransmission request in case of  $PH = 2$  in this embodiment.

[0171] In Fig. 15, 1501 - 1505 show that two sequence numbers ( $PL(0)$  (1502) and  $PL(1)$  (1504)) of the priority degrees must be attached to the packet header when two priority degrees are set in a system according to the related art. 1506 - 1510 show an example in which one of priority degree data  $PLD$  (1509), identifier  $PQ$  and identifier  $PD$  (1507, 1508) are attached when two priority degrees are set in the packet retransmitting system of this embodiment.

[0172] With reference to Fig. 15, a method for requesting retransmission of a lost packet based on the processing by the receiver of this embodiment is explained.

[0173] We assume that packets of sequence numbers 11 - 14 are lost. Since the  $PLD$  of sequence number 10 is 13, a quotient ( $Q$ ) obtained by dividing 13 by 10 is 1, and a remainder ( $R$ ) is 3. Since  $PQ$  of sequence number 10 is 01, and  $PD$  is 0,  $PL_{10}(0) = Q + R = 4$ ,  $PL_{10}(1) = R = 3$  (1511). Similarly, since the  $PLD$  of sequence number 15 is 34, a quotient ( $Q$ ) obtained by dividing 34 by 15 is 2, and a remainder ( $R$ ) is 4.  $PL_{15}(0)$  is a quotient obtained by dividing 94 by 15, and  $PL_{15}(1)$  is a remainder obtained by dividing 94 by 15. Since  $PQ$  of sequence number 15 is 01 and  $PD$  is 0,  $PL_{15}(0) = Q + R = 6$ ,  $PL_{15}(1) = R = 4$  (1512). Further, since the priority degree display  $S$  of sequence number 15 is -1, the packet of sequence number 15 is not an important packet to be retransmitted in the priority degrees 0 and 1. Accordingly, it is detected that  $PL_{10}(0) - PL_{15}(0)$ , i.e.,  $PL(0)$  of 5 and 6, are lost in the priority degree 0, and  $PL_{10}(1) - PL_{15}(1)$ , i.e.,  $PL(1)$  of 4, are lost in the priority degree 1 (1513). The retransmission packet transmitting unit 141 transmits a retransmission request packet for requesting to retransmit these  $PL$ 's to the transmitter (1514).

Embodiment 3.

[0174] In Embodiments 1 and 2, a case of PH = 2 was explained as an example. However, even when PH is larger than 2, this packet retransmitting system can be applied.

5 [0175] For example, in Fig. 7, PL is specified in case of PH = 1 ~ 2. However, for specifying the PL in case of PH = 3 ~ 4, another row of format data of a last line is added. In case of PH = 5 ~ 6, another row is further added. Information on the PL for requesting the retransmission is added.

Embodiment 4.

10

[0176] In Embodiment 1 and 2, as a determined value used by the priority degree information calculating unit 115, two examples were shown. It is also possible that another determined value is used to calculate the priority degree information. As far as the priority information is calculated based on an equation of  $PLD(N) = \text{determined value} \times SN + PL(N)$ , the packet retransmitting system and method can be applied.

15

Industrial Applicability

[0177] In the transmitting equipment, the receiving equipment and the packet retransmitting system and method using the above two equipments according to this invention, the transmitter can transfer data including a plurality of priority degrees in a packet. The receiver can judge if retransmission of a lost packet should be requested or not for each of the priority degrees. For example, in moving picture data compressed by MPEG (Moving Picture Experts Group) system, a moving picture includes I frame, P frame and B frame. Each of the frames has a priority degree. A priority degree of a packet in which I frame data are provided is the highest. A priority degree of P frame is next. A priority degree of B frame is low. In this case, according to the packet retransmitting system in which the plurality of priority degrees can be set, priority degree 0 is allocated to I frame, and P frame is allocated to priority degree 1. Therefore, even if a packet is lost, it is possible to request to retransmit only a packet in which data of I frame and P frame are provided and to retransmit the packet.

[0178] As stated, the packet retransmitting system of this invention can be applied to a server (transmitting equipment) for performing streaming distribution of multimedia data by transmitting and receiving data punctually at a determined time through Internet and wireless communication network and a client (receiving equipment).

[0179] Further, even for a packet including a plurality of priority degrees, the receiver can identify the plurality of priority degrees only by one of the priority degree data PLD.

[0180] Further, the retransmission request selecting unit can select a retransmission request of an appropriate priority degree dynamically according to a condition of the network and characteristics of the data. Therefore, it is possible to prevent congestion in the network due to the retransmission request and the retransmission. It is also possible to offer a quality which is appropriate for the condition of the network and contents to be transferred.

[0181] Further, the priority degree information calculating unit 115 can reduce a value of the priority degree data included in the priority degree information by selecting a determined value used for calculating the priority degree information appropriately. Therefore, attaching amount to a transmission packet can be reduced.

40

# Claims

1. A packet retransmitting system for transmitting a packet including a sequence number for defining a sequence of data included in each of a plurality of packets through a network and retransmitting a packet which is lost during transmission, the packet retransmitting system comprising:

45

a transmitting equipment for transmitting the plurality of packets; and  
a receiving equipment for receiving the plurality of packets sent by the transmitting equipment,

50

wherein the transmitting equipment includes a priority degree information attaching unit for defining a plurality of priority degrees indicating an importance degree of the data, producing priority degree information by using the plurality of priority degrees defined, and attaching the priority degree information produced to the packet, a transmitting unit for transmitting a plurality of packets to which the priority degree information is attached by the priority degree information attaching unit through the network, and a retransmitting unit for receiving a retransmission request for requesting to retransmit a packet from the receiving equipment after the transmitting unit transmits the plurality of packets and retransmitting the packet of which retransmission is requested in the retransmission request received,

55

- wherein the receiving equipment includes a receiving unit for receiving the plurality of packets sent by the transmitting equipment through the network and a retransmission requesting unit for inputting the plurality of packets received by the receiving unit, extracting a plurality of sequence numbers and a plurality of priority degree information from each of the plurality of packets input, judging lost packets based on the plurality of sequence numbers extracted, detecting an important packet among the lost packets judged based on the plurality of priority degree information extracted, and transmitting the retransmission request to the transmitting equipment to request to retransmit the packet detected.
2. A transmitting equipment for transmitting a packet including a sequence number for defining a sequence of data included in each of a plurality of packets through a network comprising:
    - a priority degree information attaching unit for defining a plurality of priority degrees indicating an importance degree of the data, producing priority degree information by using the plurality of priority degrees defined, and attaching the priority degree information produced to the packet; and
    - a transmitting unit for transmitting the packet to which the priority degree information is attached by the priority degree information attaching unit through the network.
  3. The transmitting equipment of Claim 2, wherein the priority degree information attaching unit includes
    - a priority degree setting unit for setting an importance degree for each of the plurality of priority degrees,
    - a priority degree memory for storing the plurality of priority degrees set by the priority degree setting unit, and
    - a priority degree information calculating unit for producing the priority degree information by using the plurality of priority degrees stored in the priority degree memory and the sequence number included in the packet.
  4. The transmitting equipment of Claim 3, wherein the priority degree setting unit defines the plurality of priority degrees hierarchically by setting an order, wherein the priority degree information calculating unit calculates the priority degree information by giving priority to a priority degree in a high order.
  5. The transmitting equipment of Claim 4, wherein the priority degree setting unit selects a priority degree one by one from a higher order among the plurality of priority degrees, judges an importance degree of data included in the packet based on the priority degree selected, and increases a value of the priority degree selected by one and sets the value of the priority degree selected when it is judged as an important packet.
  6. The transmitting equipment of Claim 5, wherein the priority degree information calculating unit produces the priority degree information by using a result of adding one of values of the plurality of priority degrees corresponding to the packet to a product of a determined value and the sequence number included in the packet.
  7. The transmitting equipment of Claim 6, wherein, when a number of the plurality of priority degrees is defined as PH, a value of the plurality of priority degrees is defined as PL (PH), a counter is defined as N, a sequence number included in an arbitrary packet is defined as SN, and a value of the priority degree information calculated for each of the plurality of priority degrees is defined as PLD (PH) for the arbitrary packet, the priority degree information calculating unit substitutes PL (0) for PLD (0) and calculates  $PLD(N) = \text{the determined value} \times SN + PL(N)$  for each of N in a value of  $0 < N < PH$ , defines PLD (PH - 1) in case of  $N = PH - 1$  as the priority degree information PLD of the arbitrary packet, obtains the priority degree information by calculating PLD (PH - 1) for each of the plurality of packets, and calculates the plurality of priority degree information.
  8. A transmitting equipment of Claim 7, wherein the priority degree information calculating unit uses a value of PLD (N - 1) as the determined value.
  9. The transmitting equipment of Claim 7, wherein the priority degree information calculating unit uses one of  $(IPLD(N - 1) - PL(N))$  which is an absolute value of a difference between PLD (N - 1) and PL (N),  $(ISN - PLD(N - 1))$  which is an absolute value of a difference between SN and PLD (N - 1), and  $(ISN - PL(N))$  which is an absolute value of a difference between SN and PL (N) as the determined value.
  10. The transmitting equipment of Claim 9, wherein the priority degree information calculating unit defines a minimum value among  $|PLD(N - 1) - PL(N)|$ ,  $|ISN - PLD(N - 1)|$ ,  $|ISN - PL(N)|$  as Q, defines an identifier for identifying which value among three values is defined as Q as PQ, defines an identifier for identifying which is larger between X and Y as PD when  $Q = |X - Y|$ , sets  $PQ = \text{TYPE1}$ ,  $PD = 0$ ,  $R = PL(N)$  in case of  $Q = |IPLD(N - 1) - PL(N)|$  and  $PLD(N - 1) \geq PL(N)$ , sets  $PQ = \text{TYPE1}$ ,  $PD = 1$ ,  $R = PLD(N - 1)$  in case of  $Q = |IPLD(N - 1) - PL(N)|$  and  $PLD(N - 1) < PL(N)$ .

# EP 1 246 409 A1

( $N - 1$ ) < PL (N), sets PQ = TYPE2, PD = 0, R = PL (N) in case of  $Q = \text{ISN} - \text{PLD} (N - 1)$  and  $\text{SN} \geq \text{PLD} (N - 1)$ , sets PQ = TYPE2, PD = 1 in case of  $Q = \text{ISN} - \text{PLD} (N - 1)$  and  $\text{SN} < \text{PLD} (N - 1)$ , and sets PQ = TYPE3, PD = 0, R = PLD (N - 1) in case of  $Q = \text{ISN} - \text{PL} (N)$ , and calculates PLD (PH - 1), wherein the priority degree information attaching unit attaches PLD (PH - 1), PQ and PD to the packet as the priority degree information.

11. The transmitting equipment of Claim 2, further comprising a retransmitting unit for receiving a retransmission request packet for requesting retransmission of a packet after transmitting the plurality of packets from the transmitting unit, retrieving a packet of which retransmission is requested in the retransmission request packet received, and retransmitting the packet retrieved.

12. A receiving equipment comprising:

a receiving unit for receiving a plurality of packets including a sequence number which defines a sequence of data included in each of the plurality of packets and priority degree information produced based on a plurality of priority degrees indicating an importance degree of data included through a network; and  
a retransmission requesting unit for inputting the plurality of packets received by the receiving unit, extracting a plurality of sequence numbers and a plurality of priority degree information from each of the plurality of packets input, judging lost packets based on the plurality of sequence numbers extracted, detecting an important packet among the lost packets judged based on the plurality of priority degree information, and transmitting a retransmission request to request to retransmit the packet detected.

13. The receiving equipment of Claim 12, wherein the retransmission requesting unit detects the important packet by using the importance degree indicated in each of the plurality of priority degrees included in the plurality of priority degree information.

14. The receiving equipment of Claim 13, wherein the retransmission requesting unit includes  
a packet information memory for storing the plurality of sequence numbers and the plurality of priority degree information extracted,  
a priority degree calculating unit for calculating a value of a plurality of priority degrees by using the sequence numbers and the priority degree information stored in the packet information memory, and  
a lost packet detecting unit for judging a lost packet based on the plurality of sequence numbers and detecting if any important packet is lost based on the value of the plurality of priority degrees calculated by the priority degree calculating unit.

15. The receiving equipment of Claim 14, wherein the priority degree calculating unit calculates a quotient and a remainder by dividing the priority degree information by the sequence number, and calculates a value of the plurality of priority degrees by using the quotient and the remainder calculated.

16. The receiving equipment of Claim 15, wherein, when the priority degree information is defined as PLD, the sequence number included in an arbitrary packet is defined as SN, a number of the plurality of priority degrees is defined as PH, a value of the plurality of priority degrees is defined as PL (PH), and a counter is defined as N for an arbitrary packet, the priority degree information calculating unit substitutes an initial value of N in a range of  $0 \leq N < \text{PH} - 1$ , substitutes a remainder of  $\text{PLD} / \text{SN}$  for PL (N), substitutes a quotient of  $\text{PLD} / \text{SN}$  for PLD, repeats a calculation of deducting N by 1 till N reaches 0, calculates a value of the plurality of priority degrees by substituting a value of PLD for PL (0) in case of  $N = 0$ , calculates PL (PH) for each of the plurality of packets, and calculates the value of the plurality of priority degrees corresponding to the plurality of packets, wherein the lost packet detecting unit judges if a packet with a priority degree indicated by PL (N) is lost based on a difference between values of a maximum value in PL (N) corresponding to each of the plurality of packets received and PL (N) of the arbitrary packet, and when the packet has been lost, detects the PL (N) of the packet.

17. The receiving equipment of 15, wherein the priority degree information includes priority degree data produced from the plurality of priority degrees, an identifier for indicating a type of data used for producing the priority degree data, and a flag for indicating a size of a value of the identifier for each of arbitrary packets, wherein, when the priority degree data are defined as PLD, the identifier is defined as PQ, the flag is defined as PD, a number of the plurality of priority degrees is defined as PH, a value of the plurality of priority degrees is defined as PL (PH), and a counter is defined as N for an arbitrary packet, the priority degree information calculating unit substitutes an initial value of N in a range of  $0 \leq N < \text{PH} - 1$ , defines TYPE 1, TYPE2 and TYPE 3 as types of the identifier PQ, defines that a value of the flag PD is one of 0 and 1, defines a quotient Q obtained by dividing PLD

- by SN as Q and a remainder as R, sets  $PL(N) = R$  and substitutes  $Q + R$  for PLD in case of  $PQ = TYPE1$  and  $PD = 0$ , sets  $PL(N) = Q + R$  and substitutes R for PLD in case of  $PQ = TYPE1$  and  $PD = 1$ , sets  $PL(N) = R$  and substitutes  $SN - Q$  for PLD in case of  $PQ = TYPE2$  and  $PD = 0$ , sets  $PL(N) = R$  and substitutes  $Q + SN$  for PLD in case of  $PQ = TYPE2$  and  $PD = 1$ , sets  $PL(N) = SN - Q$  and substitutes R for PLD in case of  $PQ = TYPE3$ , repeats a calculation of deducting N by 1 from  $N = PH - 1$  to  $N = 1$ , calculates PL from  $PL(0)$  to  $PL(PH - 1)$  by substituting PLD for  $PL(0)$  in case of  $N = 1$ , wherein the lost packet detecting unit judges if an important packet in the priority degree N is lost based on a difference between values of a maximum value of  $PL(N)$  of a packet and  $PL(N)$  of an arbitrary packet among the plurality of packets received by the receiving unit and detects the  $PL(N)$  of the packet lost when the packet has been lost.
18. The receiving equipment of Claim 14, wherein the retransmission requesting unit further includes a retransmission request selecting unit for selecting a particular priority degree among the plurality of priority degrees, wherein the lost packet detecting unit detects loss of a packet based on the particular priority degree selected by the retransmission request selecting unit.
19. A packet retransmitting method for transmitting a packet including a sequence number for defining a sequence of data included in each of a plurality of packets from a transmitter to a receiver through a network and retransmitting a packet which is lost during transmission, the packet retransmitting method comprising:
- in the transmitter,
- defining a plurality of priority degrees indicating an importance degree of data;
- producing priority degree information by using the plurality of priority degrees defined;
- attaching the priority degree information produced to the packet;
- repeating producing the priority degree information and attaching the priority degree information to each of the plurality of packets; and
- transmitting the plurality of packets to which the priority degree information is attached to the receiver through the network, and
- in the receiver,
- receiving the plurality of packets through the network;
- extracting a plurality of sequence numbers and a plurality of priority degree information from each of the plurality of packets received;
- judging lost packets based on the plurality of sequence extracted;
- detecting an important packet among the lost packets judged based on the plurality of priority degree information extracted; and
- transmitting a retransmission request to the transmitter to request to retransmit the packet detected.
20. A packet transmitting method for transmitting a packet including a sequence number for defining a sequence of data included in each of a plurality of packets through a network, the method comprising:
- defining a plurality of priority degrees indicating an importance degree of the data;
- producing priority degree information by using the plurality of priority degrees defined;
- attaching the priority degree information produced to the packet; and
- transmitting the packet to which the priority degree information is attached through the network.
21. A packet transmitting method of Claim 20, wherein the step of defining priority degrees includes
- defining the plurality of priority degrees hierarchically by setting an order,
- selecting a priority degree is selected from a higher priority degree among the plurality of priority degrees,
- judging an importance degree in the selected priority degree, and
- adding one to a value of the selected priority degree when it is judged as an important packet,
- wherein the step of producing the priority degree information includes producing the priority degree information by using a result of adding a value of one of the plurality of priority degrees corresponding to the packet to a product of a determined value and a sequence number included in the packet.
22. The packet transmitting method of Claim 21, wherein the step of defining the priority degrees includes setting values of the plurality of priority degrees corresponding to the plurality of packets by setting a value of the plurality of priority degrees repeatedly for the plurality of packets,
- wherein the step of producing the priority degree information includes producing the priority degree informa-

tion corresponding to each of the plurality of packets by producing the priority degree information repeatedly for the plurality of packets.

23. A packet receiving method comprising:

5

receiving a plurality of packets including a sequence number for defining a sequence of data included in each of the plurality of packets and priority degree information produced based on a plurality of priority degrees indicating an importance degree of data stored in each of the plurality of packets through a network;

10

extracting a plurality of sequence numbers and a plurality of priority degree information from the plurality of packets received;

judging lost packets based on the plurality of sequence numbers extracted;

detecting an important packet based on the plurality of priority degree information extracted among the packets judged as the lost packets; and

15

transmitting a retransmission request for requesting to retransmit the packet detected.

20

25

30

35

40

45

50

55



Fig. 1

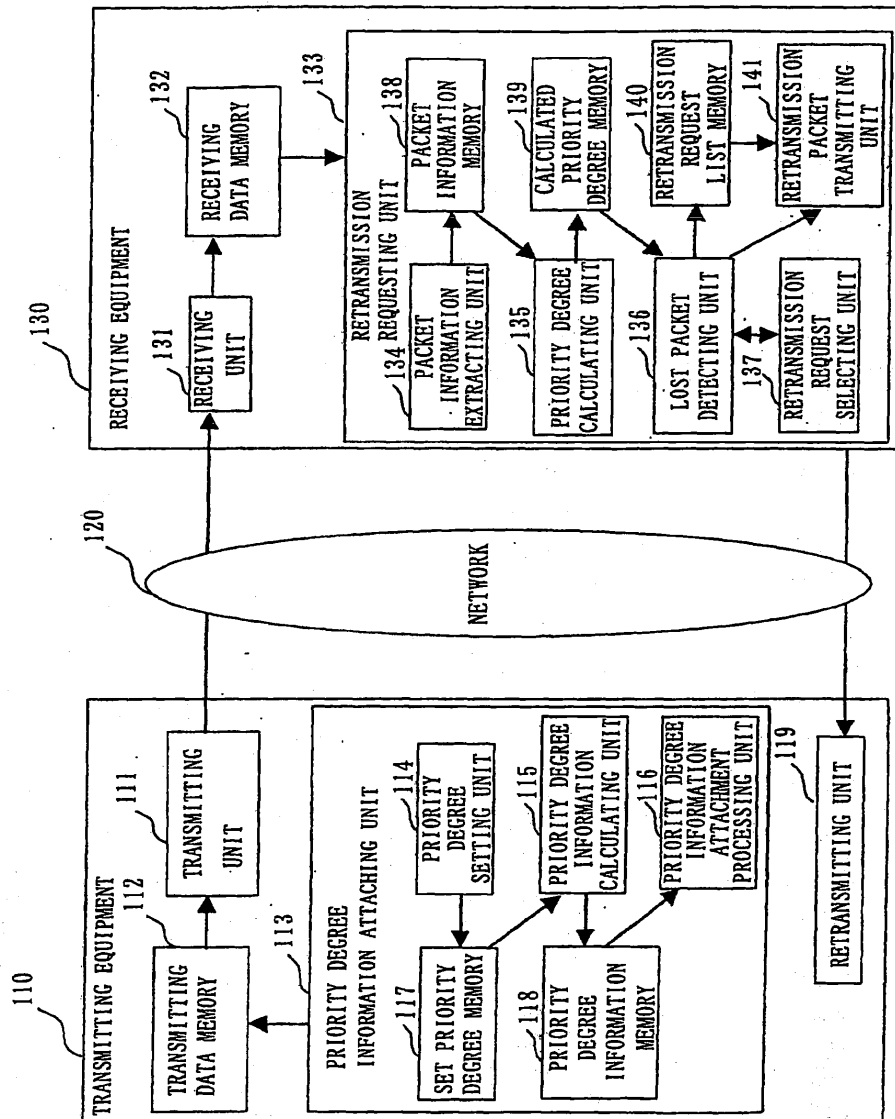


Fig. 2

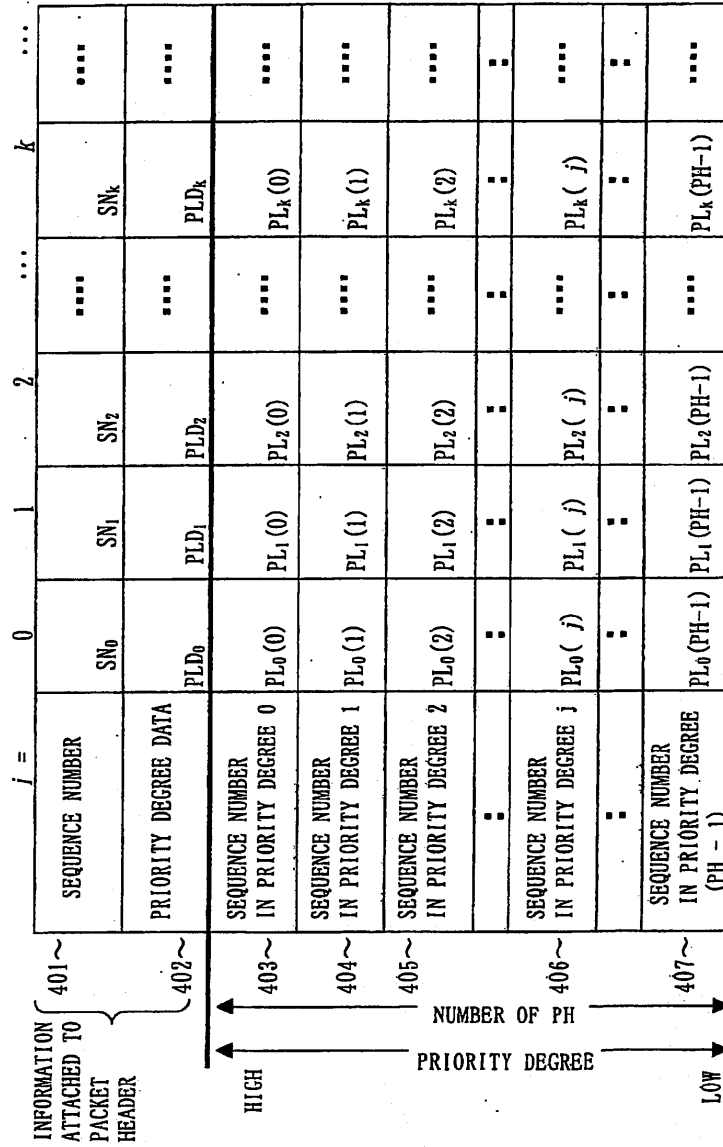


Fig. 3

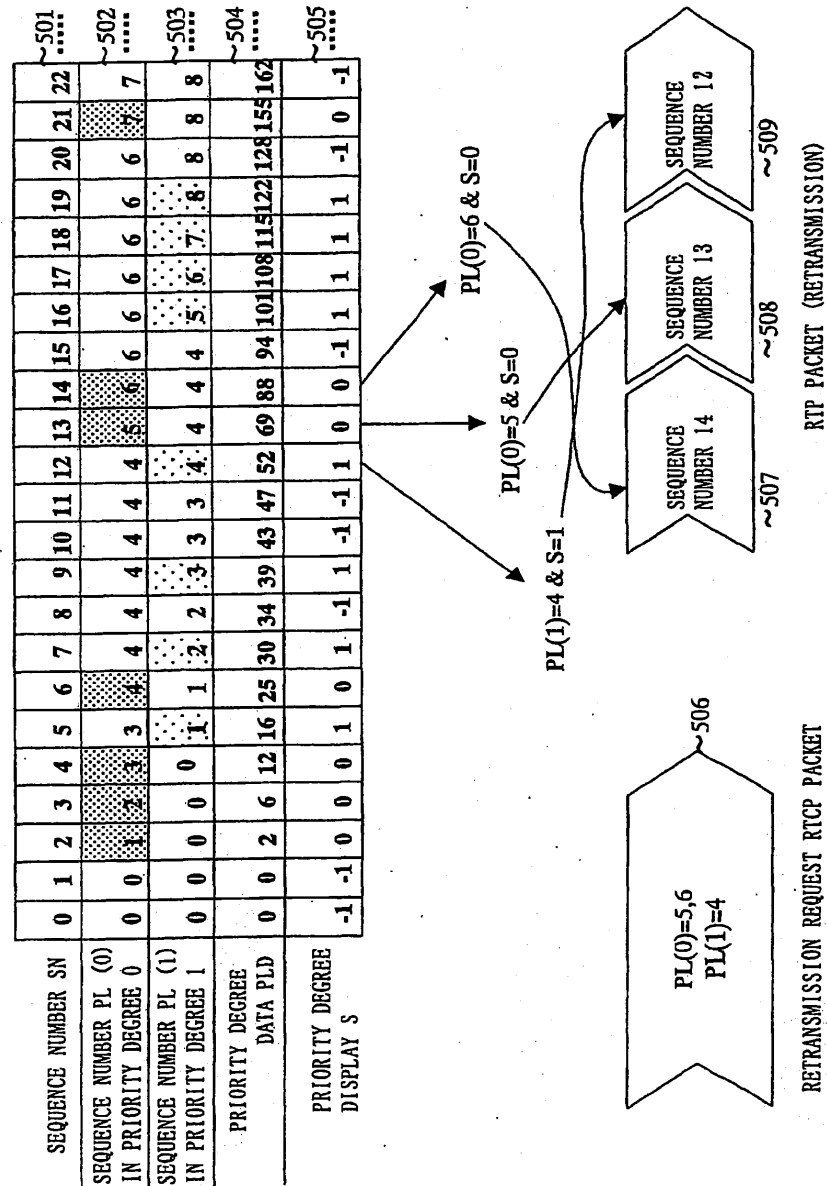


Fig. 4

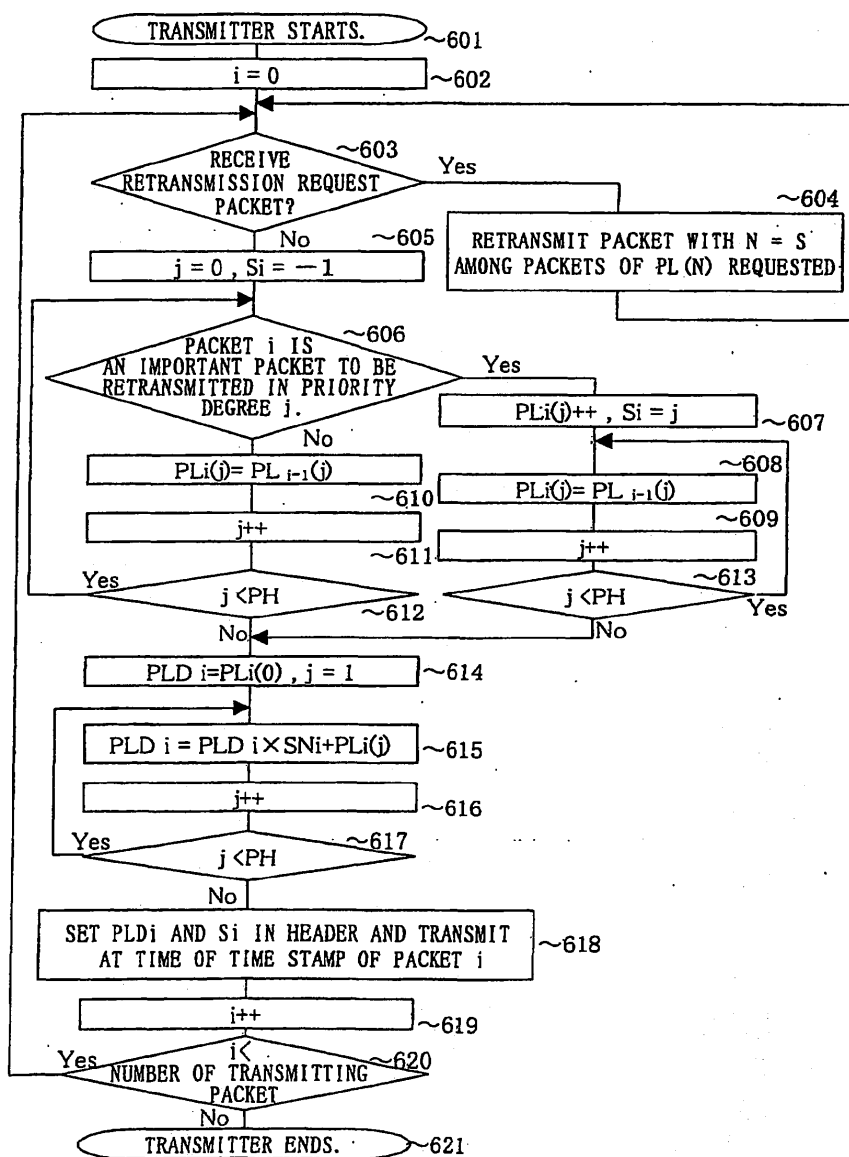


Fig. 5.

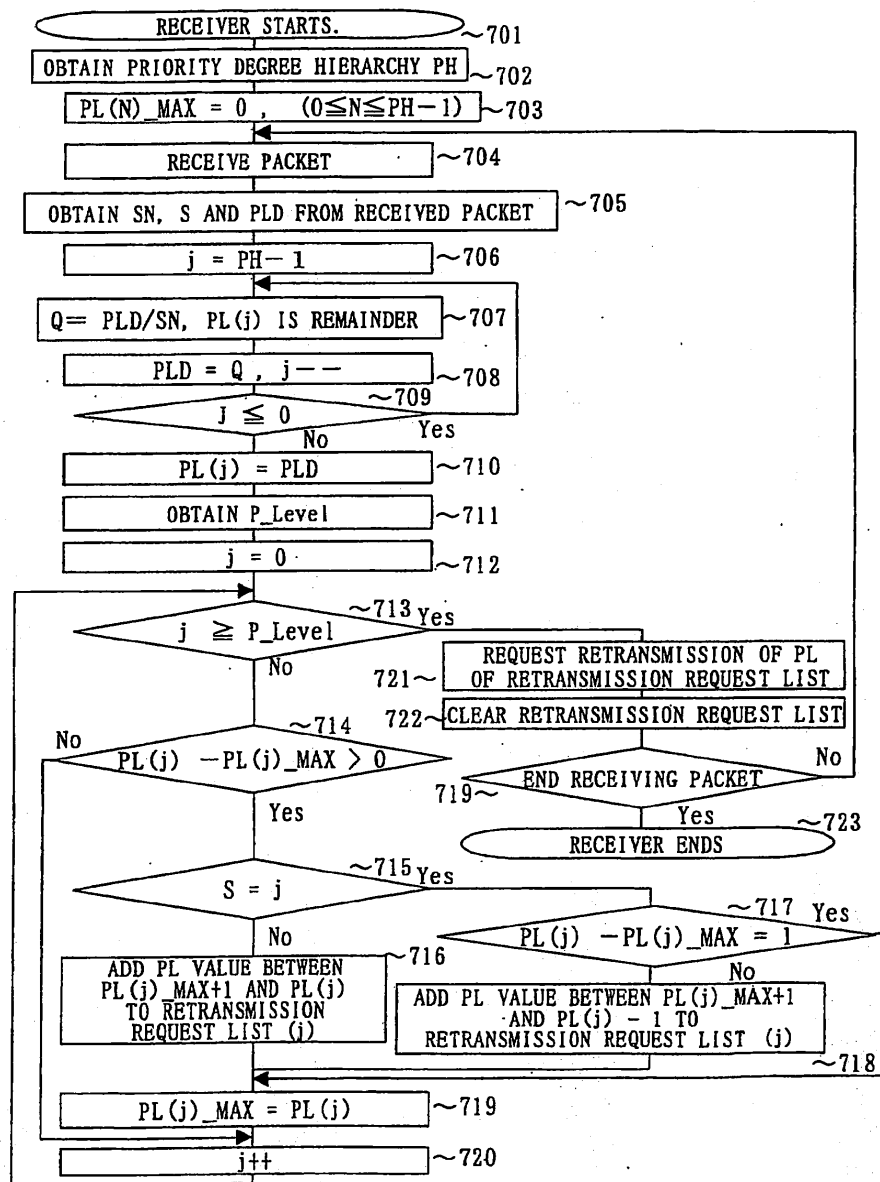


Fig. 6

|            |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |           |  |  |  |  |  |  |  |  |  |                 |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |     |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |
|------------|--|--|--|--|--|--|--|--|--|---|--|--|--|--|--|--|--|--|--|---|--|--|--|--|--|--|--|--|--|----|--|--|--|--|--|--|--|--|--|---|--|--|--|--|--|--|--|--|--|----|--|--|--|--|--|--|--|--|--|-----------|--|--|--|--|--|--|--|--|--|-----------------|--|--|--|--|--|--|--|--|--|---|--|--|--|--|--|--|--|--|--|-----|--|--|--|--|--|--|--|--|--|---|--|--|--|--|--|--|--|--|--|---|--|--|--|--|--|--|--|--|--|
| 0          |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  | 1  |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  | 2         |  |  |  |  |  |  |  |  |  |                 |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  | 3   |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |
| 0          |  |  |  |  |  |  |  |  |  | 1 |  |  |  |  |  |  |  |  |  | 2 |  |  |  |  |  |  |  |  |  | 3  |  |  |  |  |  |  |  |  |  | 4 |  |  |  |  |  |  |  |  |  | 5  |  |  |  |  |  |  |  |  |  | 6         |  |  |  |  |  |  |  |  |  | 7               |  |  |  |  |  |  |  |  |  | 8 |  |  |  |  |  |  |  |  |  | 9   |  |  |  |  |  |  |  |  |  | 0 |  |  |  |  |  |  |  |  |  | 1 |  |  |  |  |  |  |  |  |  |
| V          |  |  |  |  |  |  |  |  |  | P |  |  |  |  |  |  |  |  |  | X |  |  |  |  |  |  |  |  |  | CC |  |  |  |  |  |  |  |  |  | M |  |  |  |  |  |  |  |  |  | PT |  |  |  |  |  |  |  |  |  |           |  |  |  |  |  |  |  |  |  | SEQUENCE NUMBER |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |     |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |
| TIME STAMP |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |           |  |  |  |  |  |  |  |  |  |                 |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |     |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |
| SSRC       |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |           |  |  |  |  |  |  |  |  |  |                 |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |     |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |
| CSRC       |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |           |  |  |  |  |  |  |  |  |  |                 |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |     |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |
| S          |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  | PT |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  | Diff Time |  |  |  |  |  |  |  |  |  |                 |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  | PLD |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |

Fig. 7

| 0                                             |  |   |  |    |  |  |  |    |  | 1                                             |  |  |  |  |  |        |  |  |  | 2                                             |  |  |  |  |  |  |  |  |  | 3                                             |  |  |  |  |  |  |  |  |  |
|-----------------------------------------------|--|---|--|----|--|--|--|----|--|-----------------------------------------------|--|--|--|--|--|--------|--|--|--|-----------------------------------------------|--|--|--|--|--|--|--|--|--|-----------------------------------------------|--|--|--|--|--|--|--|--|--|
| 0 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 |  |   |  |    |  |  |  |    |  | 0 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 |  |  |  |  |  |        |  |  |  | 0 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 |  |  |  |  |  |  |  |  |  | 0 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 |  |  |  |  |  |  |  |  |  |
| V                                             |  | P |  | RC |  |  |  | PT |  |                                               |  |  |  |  |  | LENGTH |  |  |  |                                               |  |  |  |  |  |  |  |  |  |                                               |  |  |  |  |  |  |  |  |  |
| SSRC                                          |  |   |  |    |  |  |  |    |  |                                               |  |  |  |  |  |        |  |  |  |                                               |  |  |  |  |  |  |  |  |  |                                               |  |  |  |  |  |  |  |  |  |
| CSRC                                          |  |   |  |    |  |  |  |    |  |                                               |  |  |  |  |  |        |  |  |  |                                               |  |  |  |  |  |  |  |  |  |                                               |  |  |  |  |  |  |  |  |  |
| FIRST PL (0)                                  |  |   |  |    |  |  |  |    |  | LAST PL (0)                                   |  |  |  |  |  |        |  |  |  | FIRST PL (1)                                  |  |  |  |  |  |  |  |  |  | LAST PL (1)                                   |  |  |  |  |  |  |  |  |  |

Fig. 8

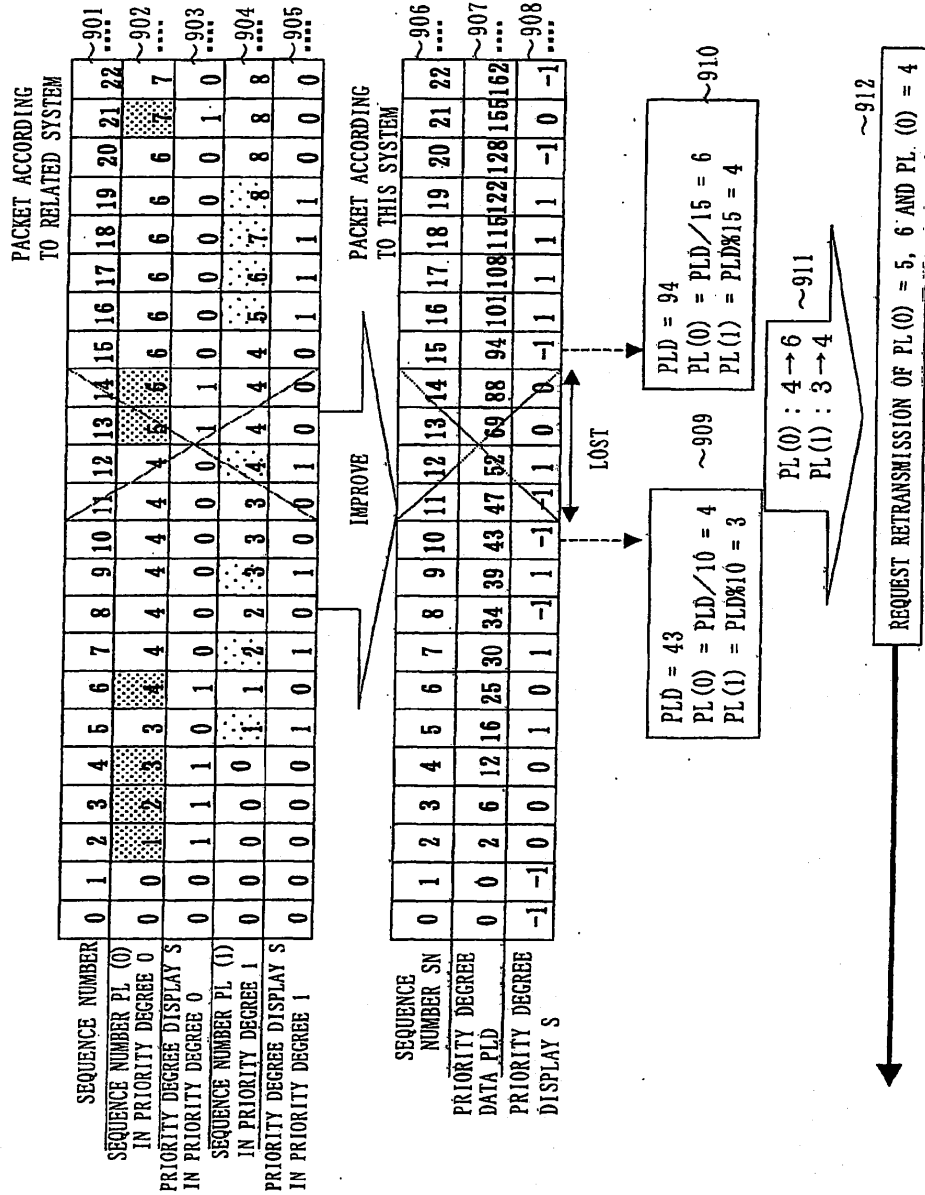




Fig. 9

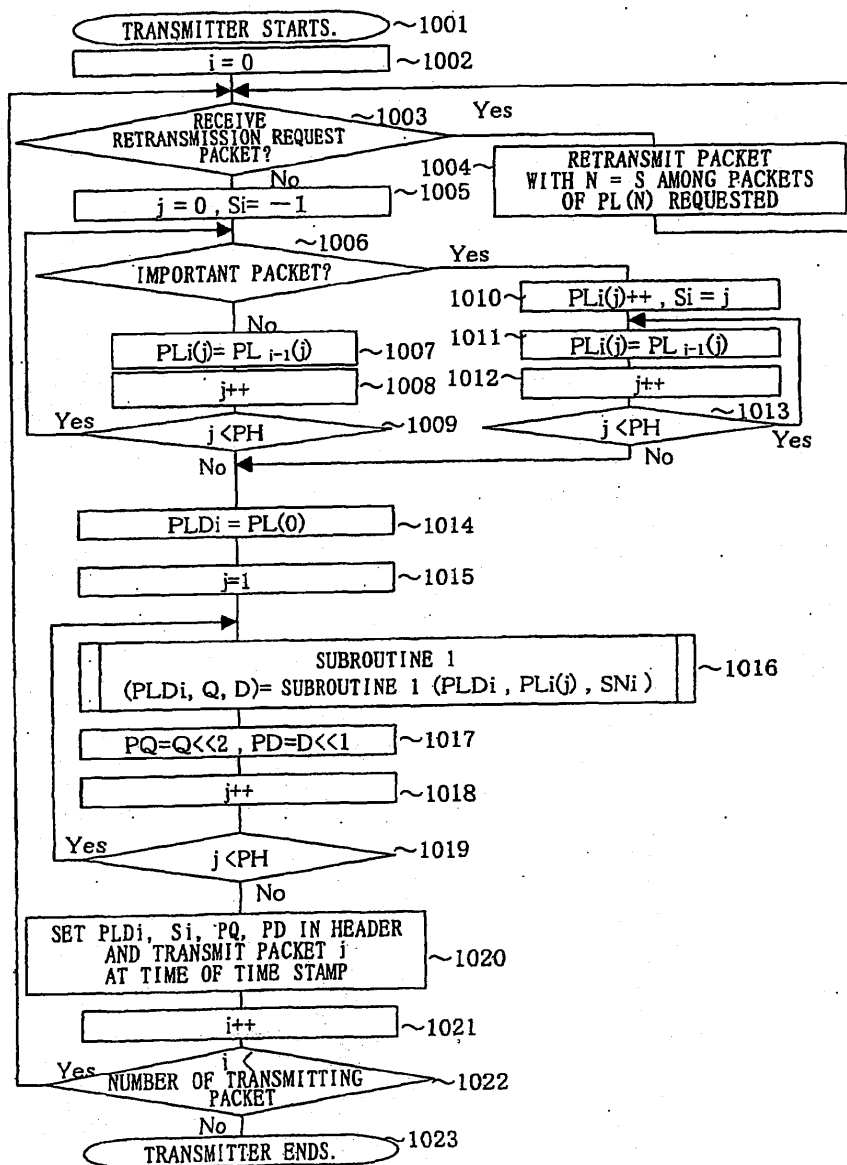


Fig. 10

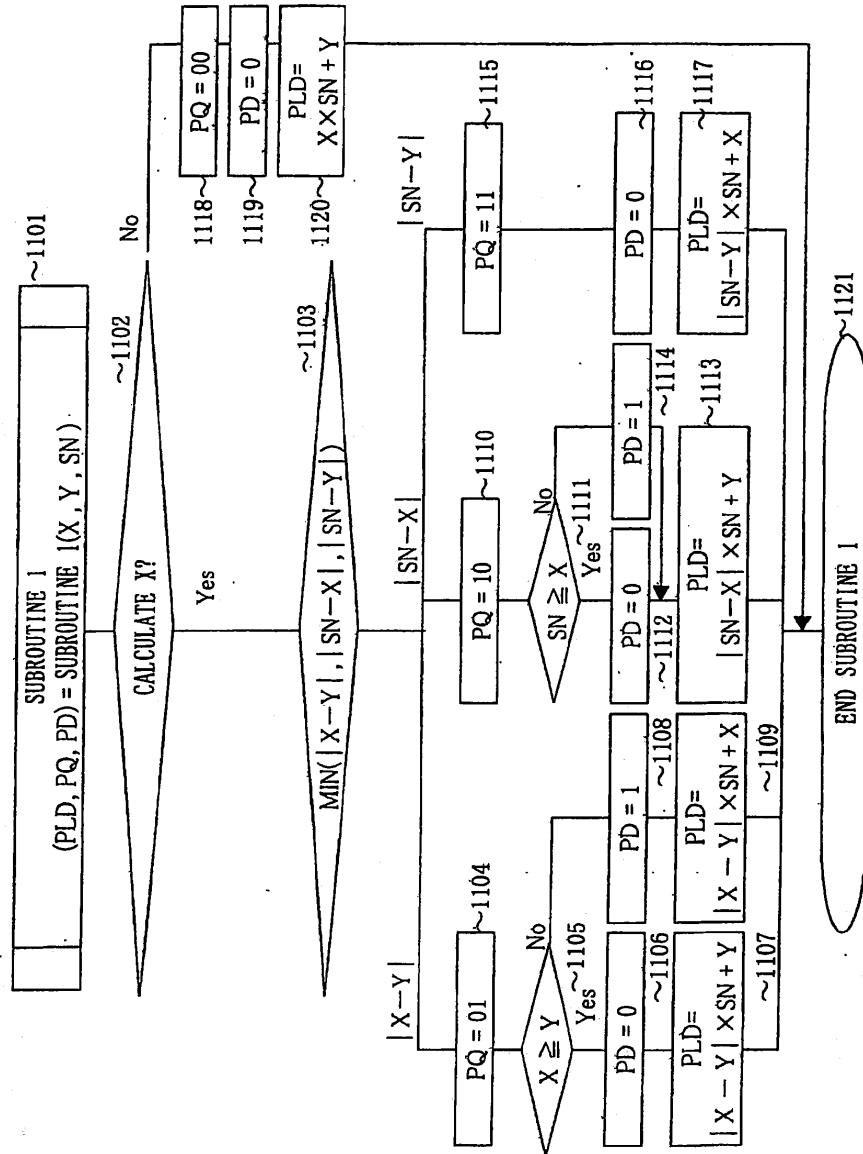


Fig.11

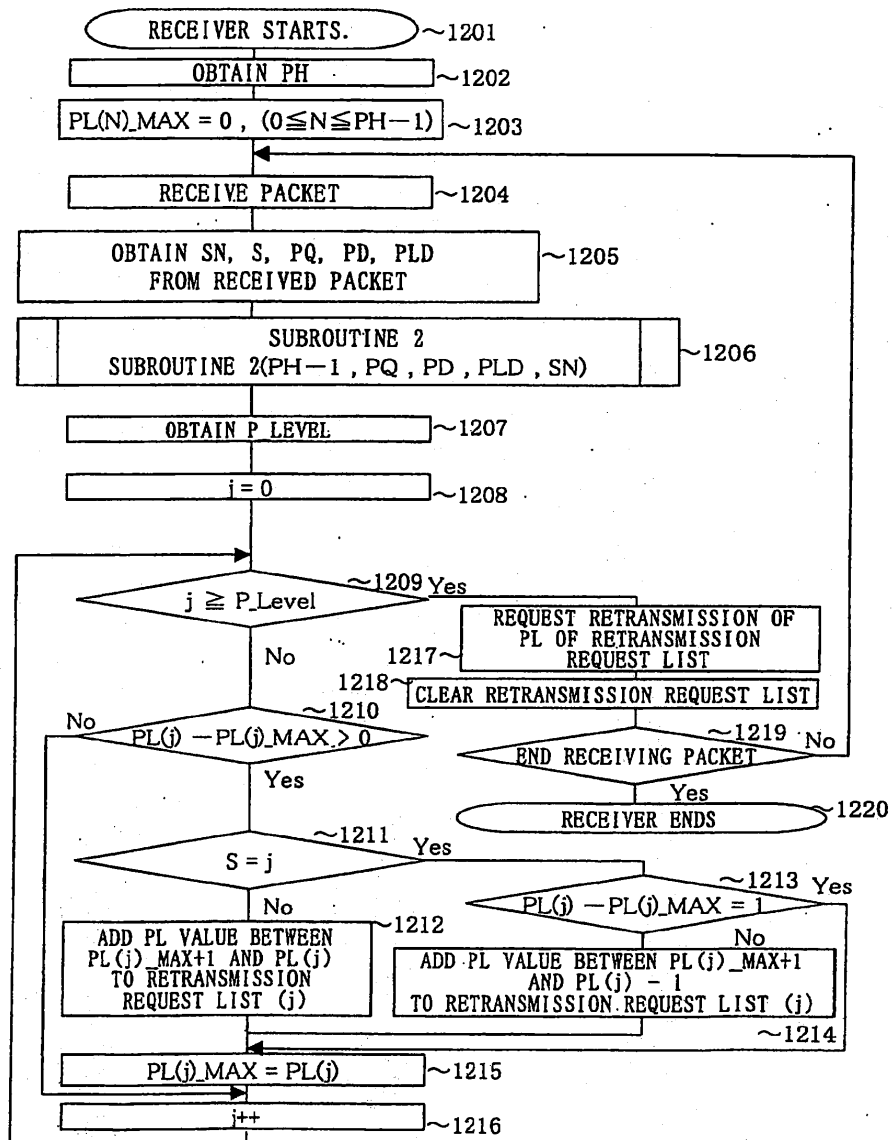


Fig. 12

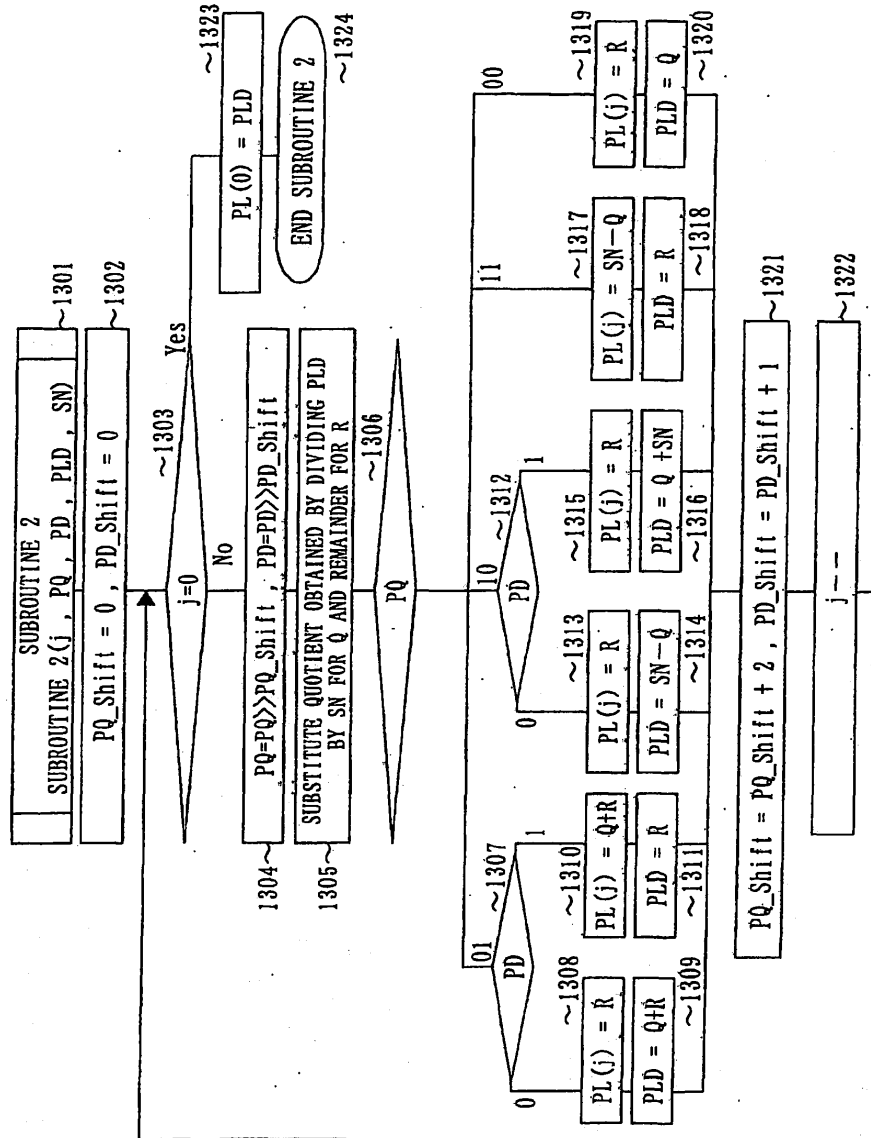


Fig. 13

|            |    |   |    |   |           |                 |   |   |    |    |     |   |   |   |   |   |   |   |   |   |   |
|------------|----|---|----|---|-----------|-----------------|---|---|----|----|-----|---|---|---|---|---|---|---|---|---|---|
| 0          | 1  | 2 | 3  | 4 | 5         | 6               | 7 | 8 | 9  | 0  | 1   | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 |
| V          | P  | X | CC | M | PT        | SEQUENCE NUMBER |   |   |    |    |     |   |   |   |   |   |   |   |   |   |   |
| TIME STAMP |    |   |    |   |           |                 |   |   |    |    |     |   |   |   |   |   |   |   |   |   |   |
| SSRC       |    |   |    |   |           |                 |   |   |    |    |     |   |   |   |   |   |   |   |   |   |   |
| CSRC       |    |   |    |   |           |                 |   |   |    |    |     |   |   |   |   |   |   |   |   |   |   |
| S          | PT |   |    |   | Diff Time |                 |   |   | PQ | PD | PLD |   |   |   |   |   |   |   |   |   |   |

Fig. 14

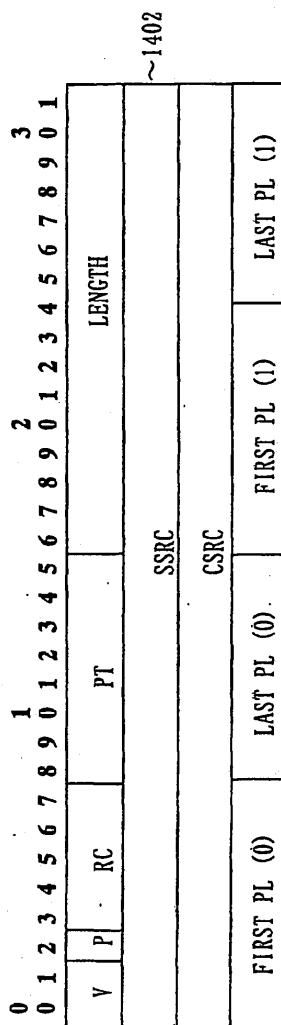


Fig. 15

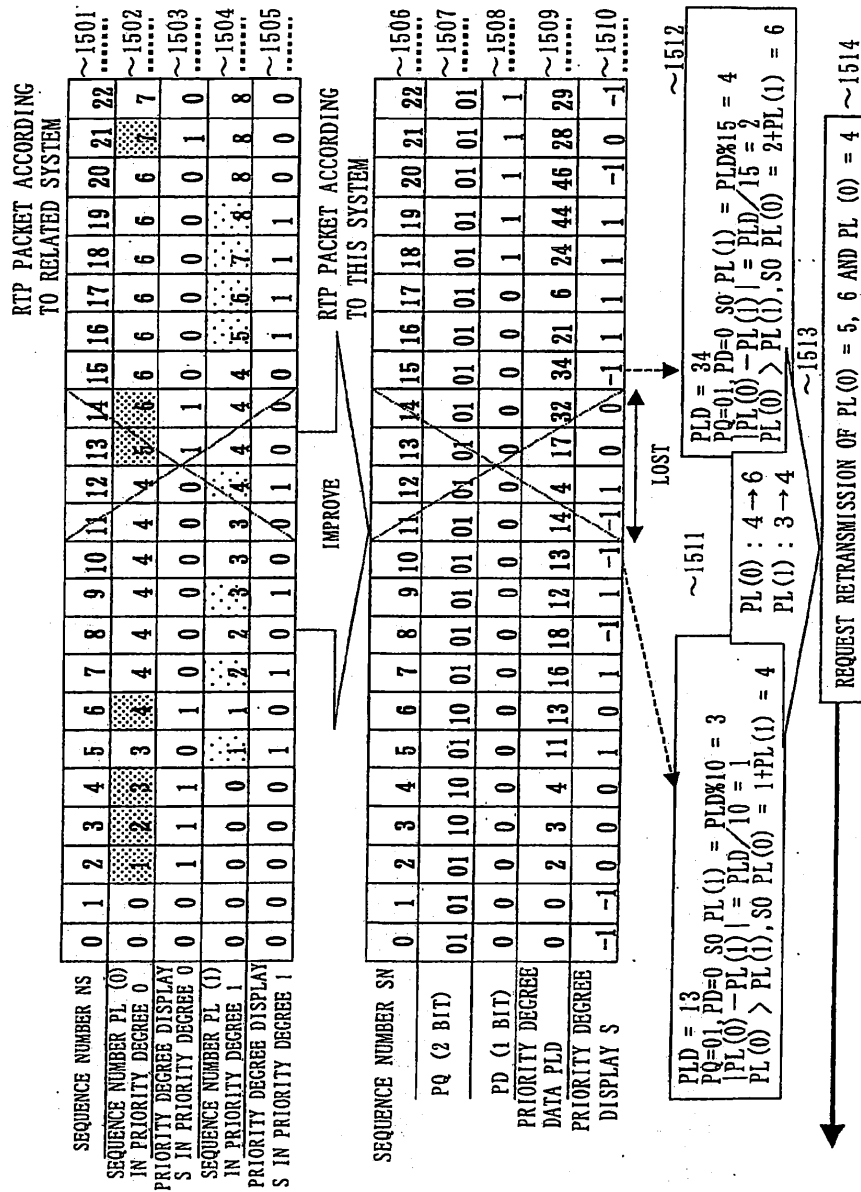


Fig. 16

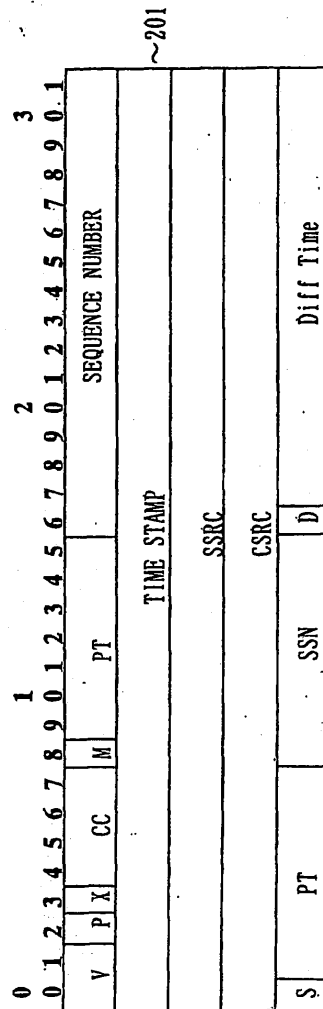




Fig. 17

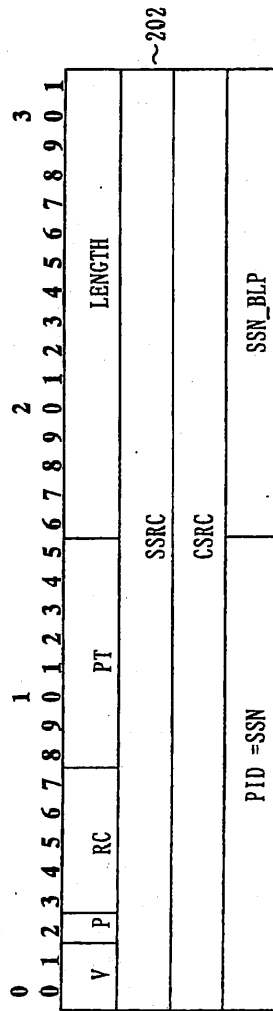
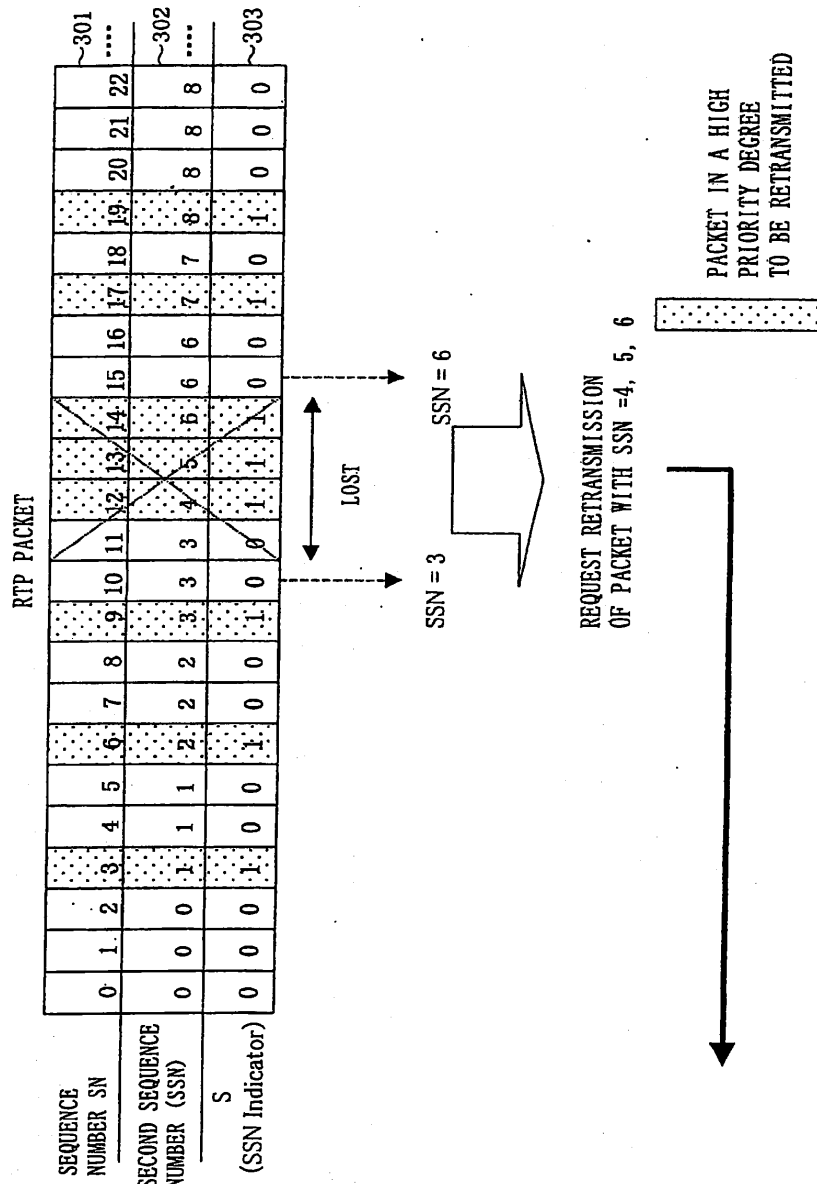


Fig. 18



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP00/06941

## A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl.<sup>7</sup> H04L12/56, H04L1/16, H04L29/08

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl.<sup>7</sup> H04L12/56, H04L1/16, H04L29/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

|                           |           |                            |           |
|---------------------------|-----------|----------------------------|-----------|
| Jitsuyo Shinan Koho       | 1922-1996 | Toroku Jitsuyo Shinan Koho | 1994-2000 |
| Kokai Jitsuyo Shinan Koho | 1971-2000 | Jitsuyo Shinan Toroku Koho | 1996-2000 |

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

JICST FILE (JOIS)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                          | Relevant to claim No. |
|-----------|-----------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X         | JP 2000-228676 A (Matsushita Electric Ind. Co., Ltd.),<br>15 August, 2000 (15.08.00),<br>Figs. 1, 9 to 10<br>(Family: none) | 2, 20                 |
| A         |                                                                                                                             | 1, 3-19, 21-23        |
| A         | JP 10-65700 A (Ricoh Company, Ltd.),<br>06 March, 1998 (06.03.98),<br>Fig. 2<br>(Family: none)                              | 1-23                  |

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not

considered to be of particular relevance

"E" earlier document but published on or after the international filing

date

"L" document which may throw doubts on priority claim(s) or which is

cited to establish the publication date of another citation or other

special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other

means

"P" document published prior to the international filing date but later

than the priority date claimed

"I" later document published after the international filing date or

priority date and not in conflict with the application but cited to

understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be

considered novel or cannot be considered to involve an inventive

step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be

considered to involve an inventive step when the document is

combined with one or more other such documents, such

combination being obvious to a person skilled in the art

"Z" document member of the same patent family

Date of the actual completion of the international search  
20 December, 2000 (20.12.00)Date of mailing of the international search report  
16 January, 2001 (16.01.01)Name and mailing address of the ISA/  
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

4  
2  
6  
8

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
27 April 2006 (27.04.2006)

PCT

(10) International Publication Number  
WO 2006/044227 A1

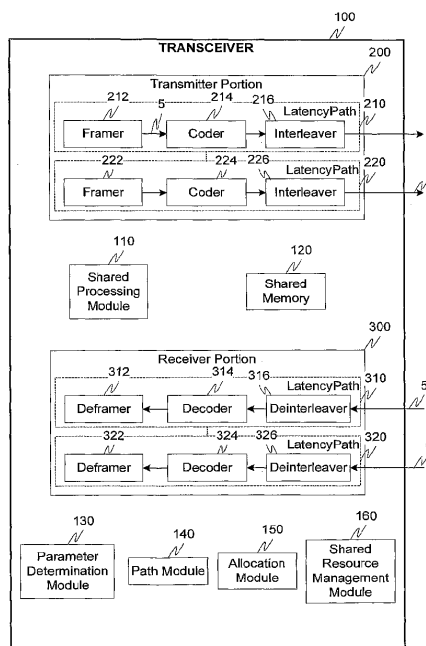
- (51) International Patent Classification:  
H04L 1/00 (2006.01) H04L 27/26 (2006.01)
- (21) International Application Number:  
PCT/US2005/036015
- (22) International Filing Date: 11 October 2005 (11.10.2005)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
60/618,269 12 October 2004 (12.10.2004) US
- (71) Applicant (for all designated States except US): **AWARE, INC.** [US/US]; 40 Middlesex Turnpike, Bedford, MA 01730-1432 (US).
- (72) Inventors: **TZANNES, Marcos, C.**; 121 La Espiral, Orinda, CA 94563 (US). **LUND, Michael**; 110 Prospect St., West Newton, MA 02465 (US).
- (74) Agent: **VICK, Jason, H.**; Miles & Stockbridge P.C., 1751 Pinnacle Dr., Suite 500, McLean, VA 22102 (US).

- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:  
— with international search report

[Continued on next page]

(54) Title: RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT



(57) Abstract: A transceiver is designed to share memory and processing power amongst a plurality of transmitter and/or receiver latency paths, in a communications transceiver that carries or supports multiple applications. For example, the transmitter and/or receiver latency paths of the transceiver can share an interleaver/deinterleaver memory. This allocation can be done based on the data rate, latency, BER, impulse noise protection requirements of the application, data or information being transported over each latency path, or in general any parameter associated with the communications system.

WO 2006/044227 A1



*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT**RELATED APPLICATION DATA

[0001] This application claims the benefit of and priority under 35 U.S.C. § 119(e) to U.S. Patent Application No. 60/618,269, filed October 12, 2004, entitled “Sharing Memory and Processing Resources in DSL Systems,” which is incorporated herein by reference in its entirety.

BACKGROUNDField of the Invention

[0002] This invention generally relates to communication systems. More specifically, an exemplary embodiment of this invention relates to memory sharing in communication systems. Another exemplary embodiment relates to processing or coding resource sharing in a communication system.

Description of Related Art

[0003] U.S. Patent Nos. 6,775,320 and 6,778,589, which are both incorporated herein by reference in their entirety, describe DSL systems supporting multiple applications and multiple framer/coder/interleaver FCI blocks (an FCI block is also referred to as a latency path). DSL systems carry applications that have different transmission requirements with regard to, for example, data rate, latency (delay), bit error rate (BER), and the like. For example, video typically requires a low BER ( $<1E-10$ ) but can tolerate higher latency ( $>20$  ms). Voice, on the other hand, typically requires a low latency ( $<1$  ms) but can tolerate BER ( $>1E-3$ ).

[0004] As described in U.S. Patent No. 6,775,320, different applications can use different latency paths in order to satisfy the different application requirements of the communication system. As a result a transceiver must support multiple latency paths in order to support applications such as video, Internet access and voice telephony. When implemented in a transceiver, each of the latency paths will have a framer, coder, and interleaver block with different capabilities that depend on the application requirements.

#### SUMMARY

[0005] One difficulty with implementing multiple latency paths in a transceiver is the fact that a latency path is a complicated digital circuit that requires a large amount of memory and processing power. An interleaver within a latency path can consume a large amount of memory in order to provide error correcting capability. For example, a typical DSL transceiver will have at least one latency path with approximately 16 kbytes of memory for the interleaver. Likewise, the coding block, for example, a Reed Solomon coder, consumes a large amount of processing power. In general, as the number of latency paths increase, the memory and processing power requirements for a communication system become larger.

[0006] Accordingly, an exemplary aspect of this invention relates to sharing memory between one or more interleavers and/or deinterleavers in a transceiver. More particularly, an exemplary aspect of this invention relates to shared latency path memory in a transceiver.



[0007] Additional aspects of this invention relate to configuring and initializing shared memory in a communication system. More particularly, an exemplary aspect of this invention relates to configuring and initializing interleaver/deinterleaver memory in a communication system.

[0008] Additional aspects of the invention relate to determining the amount of memory that can be allocated to a particular component by a communication system. More specifically, an exemplary aspect of the invention relates to determining the maximum amount of shared memory that can be allocated to one or more interleaves or deinterleavers.

[0009] According to another exemplary aspect of the invention, processing power is shared between a number of transceiver modules. More specifically, and in accordance with an exemplary embodiment of the invention, a coding module is shared between one or more coders and/or decoders.

[0010] Another exemplary embodiment of the invention relates to transitioning from a fixed memory configuration to a shared memory configuration during one or more of initialization and SHOWTIME (user data transmission).

[0011] An additional exemplary aspect of the invention relates to dynamically updating one or more of shared memory and processing resources based on changing communication conditions.

[0012] An additional exemplary aspect of the invention relates to updating one or more of shared memory and processing resources based on an updated communication parameter.

[0013] An additional exemplary aspect of the invention relates to updating the allocation of one or more of shared memory and processing resources based on an updated communication parameter(s).

[0014] Additional aspects of the invention relate to exchanging shared resource allocations between transceivers.

[0015] Additional exemplary aspects relate to a method of allocating shared memory in a transceiver comprising allocating the shared memory to a plurality of modules, wherein each of the plurality of modules comprise at least one interleaver, at least one deinterleaver or a combination thereof.

[0016] Still further aspects relate to the above method wherein the plurality of modules comprise interleavers.

[0017] Still further aspects relate to the above method wherein the plurality of modules comprise deinterleavers.

[0018] Still further aspects relate to the above method wherein the plurality of modules comprise at least one interleaver and at least one deinterleaver.

[0019] Additional exemplary aspects relate to a transceiver comprising a plurality of modules each including at least one interleaver, at least one deinterleaver or a

combination thereof and a shared memory designed to be allocated to a plurality of the modules.

[0020] Still further aspects relate to the above transceiver wherein the plurality of modules comprise interleavers.

[0021] Still further aspects relate to the above transceiver wherein the plurality of modules comprise deinterleavers.

[0022] Still further aspects relate to the above transceiver wherein the plurality of modules comprise at least one interleaver and at least one deinterleaver.

[0023] These and other features and advantages of this invention are described in, or are apparent from, the following description of the embodiments.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The embodiments of the invention will be described in detail, with reference to the following figures, wherein:

[0025] Fig. 1 is a functional block diagram illustrating an exemplary transceiver according to this invention;

[0026] Fig. 2 is a flowchart outlining an exemplary method of sharing resources according to this invention;

[0027] Fig. 3 is a flowchart outlining an exemplary method of determining a maximum amount of shared memory according to this invention; and

[0028] Fig. 4 is a flowchart outlining an exemplary resource sharing methodology according to this invention.

### DETAILED DESCRIPTION

[0029] The exemplary embodiments of this invention will be described in relation to sharing resources in a wired and/or wireless communications environment. However, it should be appreciated, that in general, the systems and methods of this invention will work equally well for any type of communication system in any environment.

[0030] The exemplary systems and methods of this invention will also be described in relation to multicarrier modems, such as DSL modems and VDSL modems, and associated communication hardware, software and communication channels. However, to avoid unnecessarily obscuring the present invention, the following description omits well-known structures and devices that may be shown in block diagram form or otherwise summarized.

[0031] For purposes of explanation, numerous details are set forth in order to provide a thorough understanding of the present invention. It should be appreciated however that the present invention may be practiced in a variety of ways beyond the specific details set forth herein.

[0032] Furthermore, while the exemplary embodiments illustrated herein show the various components of the system collocated, it is to be appreciated that the various components of the system can be located at distant portions of a distributed

network, such as a telecommunications network and/or the Internet, or within a dedicated secure, unsecured and/or encrypted system. Thus, it should be appreciated that the components of the system can be combined into one or more devices, such as a modem, or collocated on a particular node of a distributed network, such as a telecommunications network. As will be appreciated from the following description, and for reasons of computational efficiency, the components of the system can be arranged at any location within a distributed network without affecting the operation of the system. For example, the various components can be located in a Central Office modem (CO, ATU-C, VTU-O), a Customer Premises modem (CPE, ATU-R, VTU-R), a DSL management device, or some combination thereof. Similarly, one or more functional portions of the system could be distributed between a modem and an associated computing device.

[0033] Furthermore, it should be appreciated that the various links, including communications channel 5, connecting the elements can be wired or wireless links, or any combination thereof, or any other known or later developed element(s) that is capable of supplying and/or communicating data to and from the connected elements. The term module as used herein can refer to any known or later developed hardware, software, firmware, or combination thereof that is capable of performing the functionality associated with that element. The terms determine, calculate and compute, and variations thereof, as used herein are used interchangeably and include any type of methodology, process, mathematical operation or technique. FCI block and latency path are used interchangeably herein as well as transmitting modem and transmitting transceiver. Receiving modem and receiving transceiver are also used

interchangeably.

[0034] Fig. 1 illustrates an exemplary embodiment of a transceiver 100 that utilizes shared resources. It should be appreciated that numerous functional components of the transceiver have been omitted for clarity. However, the transceiver 100 can also include the standard components found in typical communications device(s) in which the technology of the subject invention is implemented into.

[0035] According to an exemplary embodiment of the invention, memory and processing power can be shared among a plurality of transmitter and/or receiver latency paths, in a communications transceiver that carries or supports multiple applications. For example, the transmitter and/or receiver latency paths of the transceiver can share an interleaver/deinterleaver memory and the shared memory can be allocated to the interleaver and/or deinterleaver of each latency path. This allocation can be done based on the data rate, latency, BER, impulse noise protection requirements of the application, data or information being transported over each latency path, or in general any parameter associated with the communications system.

[0036] Likewise, for example, the transmitter and/or receiver latency paths can share a Reed-Solomon coder/decoder processing module and the processing power of this module can be allocated to each encoder and/or decoder. This allocation can be done based on the data rate/latency, BER, impulse noise protection requirements of the application data or information being transported over each latency path, or in general based on any parameter associated with the communication system.

[0037] In accordance with an exemplary operational embodiment, a first transceiver and a second transceiver transmit to one another messages during, for example, initialization which contain information on the total and/or shared memory capabilities of each transceiver and optionally information about the one or more latency paths. This information can be transmitted prior to determining how to configure the latency paths to support the application requirements. Based on this information, one of the modems can select an FCI configuration parameter(s) that meets the transmission requirements of each application being transported over each latency paths. While an exemplary of the embodiment of the invention will be described in relation to the operation of the invention and characteristics thereof being established during initialization, it should be appreciated that the sharing of resources can be modified and messages transmitted between a two transceivers at any time during initialization and/or user data transmission, i.e., SHOWTIME.

[0038] Fig. 1 illustrates an exemplary embodiment of a transceiver 100. The transceiver 100 includes a transmitter portion 200 and a receiver portion 300. The transmitter portion 200 includes one or more latency paths 210, 220, .... Similarly, the receiver portion 300 includes one or more latency paths 310, 320, .... Each of the latency paths in the transmitter portion 200 includes a framer, coder, and interleaver designated as 212, 214, 216 and 222, 224 and 226, respectively. Each of the latency paths in the receiver portion includes a deframer, decoder, and deinterleaver designated as 312, 314, 316 and 322, 324, and 326, respectively. The transceiver 100 further includes a shared processing module 110, a shared memory 120, a parameter

determination module 130, a path module 140, an allocation module 150, and a shared resource management module 160, all interconnected by one or more links (not shown).

[0039] In this exemplary embodiment, the transceiver 100 is illustrated with four total transmitter portion and receiver portion latency paths, i.e., 210, 220, 310, and 320. The shared memory 120 is shared amongst the two transmitter portion interleavers 216 and 226 and two receiver portion deinterleavers 316 and 326. The shared processing module 110, such as a shared coding module, is shared between the two transmitter portion coders 214 and 224 and the two receiver portion decoders 314 and 324.

[0040] While the exemplary embodiment of the invention will be described in relation to a transceiver having a number of transmitter portion latency paths and receiver portion latency paths, it should be appreciated that this invention can be applied to any transceiver having any number of latency paths. Moreover, it should be appreciated that the sharing of resources can be allocated such that one or more of the transmitter portion latency paths are sharing a shared resource, one or more of the receiver portion latency paths are sharing a shared resource, or a portion of the transmitter portion latency paths and a portion of the receiver portion latency paths are sharing shared resources. Moreover, any one or more of the latency paths, or portions thereof, could also be assigned to a fixed resource while, for example, another portion of the latency path(s) assigned to a shared resource. For example, in latency path 210, the interleaver 216 could be allocated a portion of the shared



memory 120, while the coder 214 could be allocated to a dedicated processing module, vice versa, or the like.

[0041] In accordance with the exemplary embodiment, a plurality of transmitter portion or receiver portion latency paths share an interleaver/deinterleaver memory, such as shared memory 120, and a coding module, such as shared processing module 110. For example, the interleaver/deinterleaver memory can be allocated to different interleavers and/or deinterleavers. This allocation can be based on parameters associated with the communication systems such as data rate, latency, BER, impulse noise protection, and the like, of the applications being transported. Similarly, a coding module, which can be a portion of the shared processing module 110, can be shared between any one or more of the latency paths. This sharing can be based on requirements such as data rate, latency, BER, impulse noise protection, and the like, of the applications being transported.

[0042] For example, an exemplary transceiver could comprise a shared interleaver/deinterleaver memory and could be designed to allocate a first portion of the shared memory 120 to an interleaver, such as interleaver 216 in the transmitter portion of the transceiver and allocate a second portion of the shared memory 120 to a deinterleaver, such as 316, in the receiver portion of the transceiver.

[0043] Alternatively, for example, an exemplary transceiver can comprise a shared interleaver/deinterleaver memory, such as shared memory 120, and be designed to allocate a first portion of shared memory 120 to a first interleaver, e.g.,

216, in the transmitter portion of the transceiver and allocate a second portion of the shared memory to a second interleaver, e.g., 226, in the transmitter portion of the transceiver.

[0044] Alternatively, for example, an exemplary transceiver can comprise a shared interleaver/deinterleaver memory and be designed to allocate a first portion of the shared memory 120 to a first deinterleaver, e.g., 316, in the receiver portion of the transceiver and allocate a second portion of the shared memory to a second deinterleaver, e.g., 326, in the receiver portion of the transceiver. Regardless of the configuration, in general any interleaver or deinterleaver, or grouping thereof, be it in a transmitter portion or receiver portion of the transceiver, can be associated with a portion of the shared memory 120.

[0045] Establishment, configuration and usage of shared resources is performed in the following exemplary manner. First, and in cooperation with the path module 140, the number of transmitter and receiver latency paths (N) is determined. The parameter determination module 130 then analyses one or more parameters such as data rate, transmitter data rate, receiver data rate, impulse noise protection, bit error rate, latency, or the like. Based on one or more of these parameters, the allocation module 150 allocates a portion of the shared memory 120 to one or more of the interleaver and/or deinterleavers, or groupings thereof. This process continues until the memory allocation has been determined and assigned to each of the N latency paths.

[0046] Having determined the memory allocation for each of the latency paths, and in conjunction with the shared resource management 160, the transceiver 100 transmits to a second transceiver one or more of the number of latency paths (N), the maximum interleaver memory for any one or more of the latency paths and/or the maximum total and/or shared memory for all of the latency paths.

[0047] Three examples of sharing interleaver/deinterleaver memory and coding processing in a transceiver are described below. The latency paths in these examples can be in the transmitter portion of the transceiver or the receiver portion of the transceiver.

[0048] Example #1

A first transmitter portion or receiver portion latency path may carry data from a video application, which needs a very low BER but can tolerate higher latency. In this case, the video will be transported using an latency path that has a large amount of interleaving/deinterleaving and coding (also known as Forward Error Correction (FEC) coding). For example, the latency path may be configured with Reed-Solomon coding using a codeword size of 255 bytes ( $N=255$ ) with 16 checkbytes ( $R=16$ ) and interleaving/deinterleaving using an interleaver depth of 64 ( $D=64$ ). This latency path will require  $N*D=16*255=16\text{Kbytes}$  of interleaver memory at the transmitter (or de-interleaver memory at the receiver). This latency path will be able to correct a burst of errors that is less than 512 bytes in duration.

[0049] A second transmitter portion or receiver portion latency path may carry an

internet access application that requires a medium BER and a medium amount of latency. In this case, the internet access application will be transported using a latency path that has a medium amount of interleaving and coding. For example, the latency path may be configured with Reed-Solomon coding using a codeword size of 128 bytes ( $N=128$ ) with 8 checkbytes ( $R=8$ ) and interleaving using an interleaver depth of 16 ( $D=32$ ). This latency path will require  $N*D=128*32=4$ Kbytes of interleaver memory and the same amount of deinterleaver memory. This latency path will be able to correct a burst of errors that is less than 128 bytes in duration.

[0050] A third transmitter portion or receiver portion latency path may carry a voice telephony application, which needs a very low latency but can tolerate BER. In this case, the video will be transported using an latency path that has a large amount of interleaving and coding. For example, the third transmitter portion or receiver portion latency path may be configured with no interleaving or coding which will result in the lowest possible latency through the latency path but will provide no error correction capability.

[0051] According to the principles of this invention, a system carrying the three applications described above in Example #1, would have three latency paths that share one memory space containing at least  $(16+4)=20$  Kbytes. The three latency paths also share a common coding block that is able to simultaneously encode (in the transmitter portion) or decode (in a receiver portion) two codewords with  $N=255/R=16$  and  $N=128/R=8$ .

[0052] According to an exemplary embodiment of this invention, the latency paths can be reconfigured at initialization or during data transmission mode (also known as SHOWTIME in ADSL and VDSL transceivers). This would occur if, for example, the applications or application requirements were to change.

[0053] Example #2

If instead of 1 video application, 1 internet application and 1 voice application, there were 3 internet access applications then the transmitter portion and/or receiver portion latency paths would be reconfigured to utilize the shared memory and coding module in a different way. For example, the system could be reconfigured to have 3 transmitter portion or receiver portion latency paths, with each latency path being configured with Reed-Solomon coding using a codeword size of 128 bytes ( $N=128$ ) with 8 checkbytes ( $R=8$ ) and interleaving using an interleaver depth of 16 ( $D=32$ ). Each latency path will require  $N*D=128*32=4\text{Kbytes}$  of interleaver memory and each block will be able to correct a burst of errors that is less than 128 bytes in duration. Based on the example of carrying the three internet access applications described, the three latency path share one memory space containing at least  $3*4=12\text{ Kbytes}$ . Also the three latency paths share a common coding block that is able to simultaneously encode (on the transmitter side) or decode (on the receiver side) three codewords with  $N=128/R=16$ ,  $N=128/R=8$  and  $N=128/R=8$ .

[0054] Example #3

The system could be configured to carry yet another set of applications. For example, the latency paths could be configured to carry 2 video applications. In this case only

2 transmitter portion or receiver portion latency paths are needed, which means that the third latency path could be simply disabled. Also, assuming that the memory is constrained based on the first example above, then the maximum shared memory for these 2 latency paths is 20 kBytes. In this case, the system could be reconfigured to have 2 latency paths, with each block being configured with Reed-Solomon coding using a codeword size of 200 bytes ( $N=200$ ) with 10 checkbytes ( $R=10$ ) and interleaving/deinterleaving using an interleaver depth of 50 ( $D=50$ ). Each latency path will require  $N*D=200*50=10\text{Kbytes}$  of interleaver memory and each block will be able to correct a burst of errors that is less than 250 bytes in duration. This configuration results in 20K of shared memory for both latency paths, which is the same as in the first example. In order to stay within the memory constraints of the latency paths, the error correction capability for each latency path is decreased to 250 bytes from 512 bytes in Example #1.

[0055] Another aspect of this invention is the how FCI configuration information is transmitted between a first modem and a second modem. FCI configuration information will depend on the requirements of the applications being transported over the DSL connection. This information may need to be forwarded during initialization in order to initially configure the DSL connection. This information may also need to be forwarded during SHOWTIME in order to reconfigure the DSL connection based on a change in applications or the application requirements.

[0056] According to one embodiment, a first modem determines the specific FCI configuration parameters, e.g.,  $N$ ,  $D$ ,  $R$  as defined above, needed to meet specific

application requirements, such as latency, burst error correction capability, etc. In order to determine the FCI configuration parameters, the first modem must know what are the capabilities of a second modem. For example, the first modem must know how many latency paths (FCI blocks) the second modem can support. Also the first modem must know the maximum amount of interleaver memory for each transmitter latency path. In addition, since the transmitter latency paths may share a common memory space the first modem must know the total shared memory for all transmitter latency paths. This way the first modem will be able to choose a configuration that can meet application requirements and also meet the transmitter portion latency path capabilities of the second modem.

[0057] For example, using values from examples above, a first transceiver could send a message to a second transceiver during initialization or during SHOWTIME containing the following information:

- Number of supported transmitter and receiver latency paths = 3
- Max Interleaver Memory for latency path #1= 16 Kbytes
- Max Interleaver Memory for latency path #2= 16 Kbytes
- Max Interleaver Memory for latency path #3= 16 Kbytes
- Maximum total/shared memory for all latency paths = 20 kBytes

Based on this information, and the application requirements, the first transceiver would select latency path settings. For example, if the applications are 1 video, 1 internet access and 1 voice application, the first transceiver could configure 3 latency paths as follows:

latency path #1 – Video: N=255, R=16, D=64

latency path #2 – Video: N=128, R=8, D=32

latency path #3 – Video: N=0, R=0, D=1 (no coding or interleaving)

[0058] This would result in a total interleaver memory of 20 kbytes.

[0059] Alternatively, if for example, there are only 2 video applications, the first transceiver could configure 2 latency paths as follows:

latency path #1 – Video: N=200, R=10, D=50

latency path #2 – Video: N=200, R=10, D=50

latency path #3 – Video: N=0, R=0, D=1 (no coding or interleaving)

[0060] This would also result in a total interleaver memory of 20 kbytes.

[0061] Alternatively, the second transceiver can determine the specific FCI configuration parameters, e.g., N, D, R as defined above, needed to meet specific application requirements, such as latency, burst error correction capability, etc. As described above for the first transceiver, in order to determine the FCI configuration parameters, the second transceiver must first know what are the capabilities of the first transceiver. In this case, the first transceiver would send a message to the second transceiver containing the information described above and based on this information and the application requirements the second transceiver would select latency path settings.



**[0062]** Fig. 2 outlines an exemplary method of allocating shared memory in a transceiver. More specifically, control begins in step S200 and continues to step S210. In step S210, one or more of shared interleaver/deinterleaver memory and/or shared coder/decoder processing resources are allocated to one or more latency paths, in a transceiver. Control then continues to step S220 where the control sequence ends.

**[0063]** Fig. 3 outlines an exemplary method of exchanging shared resource allocations according to an exemplary embodiment of this invention. In particular, control begins in step S310. In step S310, a maximum amount of shared memory that can be allocated to a specific interleaver or deinterleaver of a plurality of interleavers or deinterleavers in a transceiver is determined. Next, in step S320, the determined maximum amount for one or more of the deinterleavers and/or interleavers is transmitted to another transceiver. Messages containing additional information can also be transmitted to the other transceiver and/or received from the other transceiver. Control then continues to step S330 where the control sequence ends.

**[0064]** Fig. 4 outlines an exemplary procedure for resource sharing according to an exemplary embodiment of this invention. In particular, control begins in step S400 and continues to step S410. In step S410, the number of latency paths are determined. Then, in step S420, the latency path information (FCI block information) is transmitted to another transceiver. Messages containing additional information can also be transmitted to the other transceiver and/or received from the other transceiver. This information can be used to, for example, assist with the determination of

memory allocation in the transceiver. Moreover, the messages received from the other transceiver could specify what the memory allocation is to be based on, for example, the number of latency paths, memory allocation in the remote transceiver and required applications. Control then continues to step S430.

[0065] In step S430, and for each latency path, the steps in step 440 are performed.

[0066] In step S440, and while monitoring of allocation of resources is being performed, steps 450 and 460 are performed. More specifically, in step S450, one or more parameters associated with the communication system are determined. Then, in step S460, shared resources are allocated based on one or more of the communication parameters. Control then continues to step S470.

[0067] In step S470, the allocation of shared resources is communicated to another transceiver. Next, in step S480, a determination is made as to whether there is a change in communications that would require the adjustment of the shared resource allocation. Examples of changes in communications conditions include a change in applications being transported over the system and/or changes in the channel condition, etc. If adjustments are required, control jumps back to step S410. Otherwise, control jumps to step S490 where the control sequence ends.

[0068] The above-described system can be implemented on wired and/or wireless telecommunications devices, such a modem, a multicarrier modem, a DSL modem, an

ADSL modem, an XDSL modem, a VDSL modem, a linecard, test equipment, a multicarrier transceiver, a wired and/or wireless wide/local area network system, a satellite communication system, a modem equipped with diagnostic capabilities, or the like, or on a separate programmed general purpose computer having a communications device or in conjunction with any of the following communications protocols: CDSL, ADSL2, ADSL2+, VDSL1, VDSL2, HDSL, DSL Lite, IDSL, RADSL, SDSL, UDSL or the like.

[0069] Additionally, the systems, methods and protocols of this invention can be implemented on a special purpose computer, a programmed microprocessor or microcontroller and peripheral integrated circuit element(s), an ASIC or other integrated circuit, a digital signal processor, a hard-wired electronic or logic circuit such as discrete element circuit, a programmable logic device such as PLD, PLA, FPGA, PAL, a modem, a transmitter/receiver, any comparable means, or the like. In general, any device capable of implementing a state machine that is in turn capable of implementing the methodology illustrated herein can be used to implement the various communication methods, protocols and techniques according to this invention.

[0070] Furthermore, the disclosed methods may be readily implemented in software using object or object-oriented software development environments that provide portable source code that can be used on a variety of computer or workstation platforms. Alternatively, the disclosed system may be implemented partially or fully in hardware using standard logic circuits or VLSI design. Whether software or

hardware is used to implement the systems in accordance with this invention is dependent on the speed and/or efficiency requirements of the system, the particular function, and the particular software or hardware systems or microprocessor or microcomputer systems being utilized. The communication systems, methods and protocols illustrated herein can be readily implemented in hardware and/or software using any known or later developed systems or structures, devices and/or software by those of ordinary skill in the applicable art from the functional description provided herein and with a general basic knowledge of the computer and telecommunications arts.

[0071] Moreover, the disclosed methods may be readily implemented in software that can be stored on a storage medium, executed on programmed general-purpose computer with the cooperation of a controller and memory, a special purpose computer, a microprocessor, or the like. In these instances, the systems and methods of this invention can be implemented as program embedded on personal computer such as an applet, JAVA® or CGI script, as a resource residing on a server or computer workstation, as a routine embedded in a dedicated communication system or system component, or the like. The system can also be implemented by physically incorporating the system and/or method into a software and/or hardware system, such as the hardware and software systems of a communications transceiver.

[0072] It is therefore apparent that there has been provided, in accordance with the present invention, systems and methods for sharing resources. While this invention has been described in conjunction with a number of embodiments, it is

evident that many alternatives, modifications and variations would be or are apparent to those of ordinary skill in the applicable arts. Accordingly, it is intended to embrace all such alternatives, modifications, equivalents and variations that are within the spirit and scope of this invention.

## Claims:

1. A method for sharing resources in a transceiver comprising:  
allocating a first portion of shared memory to a first latency path and  
allocating a second portion of the shared memory to a second latency path.
2. The method of claim 1, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.
3. The method of claim 1, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.
4. The method of claim 1, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.
5. The method of claim 1, further comprising transmitting to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.
6. The method of claim 1, further comprising receiving from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.
7. The method of claim 1, further comprising allocating a shared processing module to a plurality of coding and/or decoding modules.
8. The method of claim 1, wherein the allocating of at least one portion of the shared memory is based on one or more communication parameters.
9. The method of claim 8, wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (BER).

10. A transceiver comprising:  
a first portion of shared memory that is allocated to a first latency path;  
and  
a second portion of the shared memory that is allocated to a second latency path.
11. The transceiver of claim 10, further comprising:  
an allocation module designed to allocate the shared memory based on one or more communication parameters.
12. The transceiver of claim 11, wherein at least one of the communication parameters is a data rate, a latency, an INP value or a Bit Error Rate (BER).
13. The transceiver of claim 10, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.
14. The transceiver of claim 10, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.
15. The transceiver of claim 10, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.
16. The transceiver of claim 10, further comprising a shared resource management module designed to determine information that is transmitted to another transceiver, wherein the information is used to determine a maximum amount of shared memory that can be allocated.
17. The transceiver of claim 10, further comprising a shared resource management module designed to utilize information that is received from another transceiver, wherein the information is used to determine a maximum amount of shared memory that can be allocated.

18. The transceiver of claim 10, further comprising a shared processing module designed to provide processing resources to a plurality of coding and/or decoding modules.

19. A system for sharing resources in a transceiver comprising:  
means for allocating a first portion of shared memory to a first latency path and means for allocating a second portion of the shared memory to a second latency path.

20. The system of claim 19, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.

21. The system of claim 19, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.

22. The system of claim 19, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.

23. The system of claim 19, further comprising means for transmitting to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

24. The system of claim 19, further comprising means for receiving from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

25. The system of claim 19, further comprising means for allocating a shared processing module to a plurality of coding and/or decoding modules.

26. The system of claim 19, wherein the allocating of at least one portion



of the shared memory is based on one or more communication parameters.

27. The system of claim 26, wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (BER).

28. A protocol for sharing resources in a transceiver comprising:  
allocating a first portion of shared memory to a first latency path and  
allocating a second portion of the shared memory to a second latency path.

29. The protocol of claim 28, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.

30. The protocol of claim 28, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.

31. The protocol of claim 28, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.

32. The protocol of claim 28, further comprising transmitting to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

33. The protocol of claim 28, further comprising receiving from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

34. The protocol of claim 28, further comprising allocating a shared processing module to a plurality of coding and/or decoding modules.

35. The protocol of claim 28, wherein the allocating of at least one portion of the shared memory is based on one or more communication parameters.

36. The protocol of claim 35, wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (BER).

37. An information storage media having stored thereon information that when executed allows sharing of resources in a transceiver comprising:  
information that allocates a first portion of shared memory to a first latency path and information that allocates a second portion of the shared memory to a second latency path.

38. The media of claim 37, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.

39. The media of claim 37, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.

40. The media of claim 37, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.

41. The media of claim 37, further comprising information that transmits to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

42. The media of claim 37, further comprising information that receives from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

43. The media of claim 37, further comprising information that allocates a shared processing module to a plurality of coding and/or decoding modules.

44. The media of claim 37, wherein the allocating of at least one portion of

the shared memory is based on one or more communication parameters.

45. The media of claim 44, wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (BER).

1/3

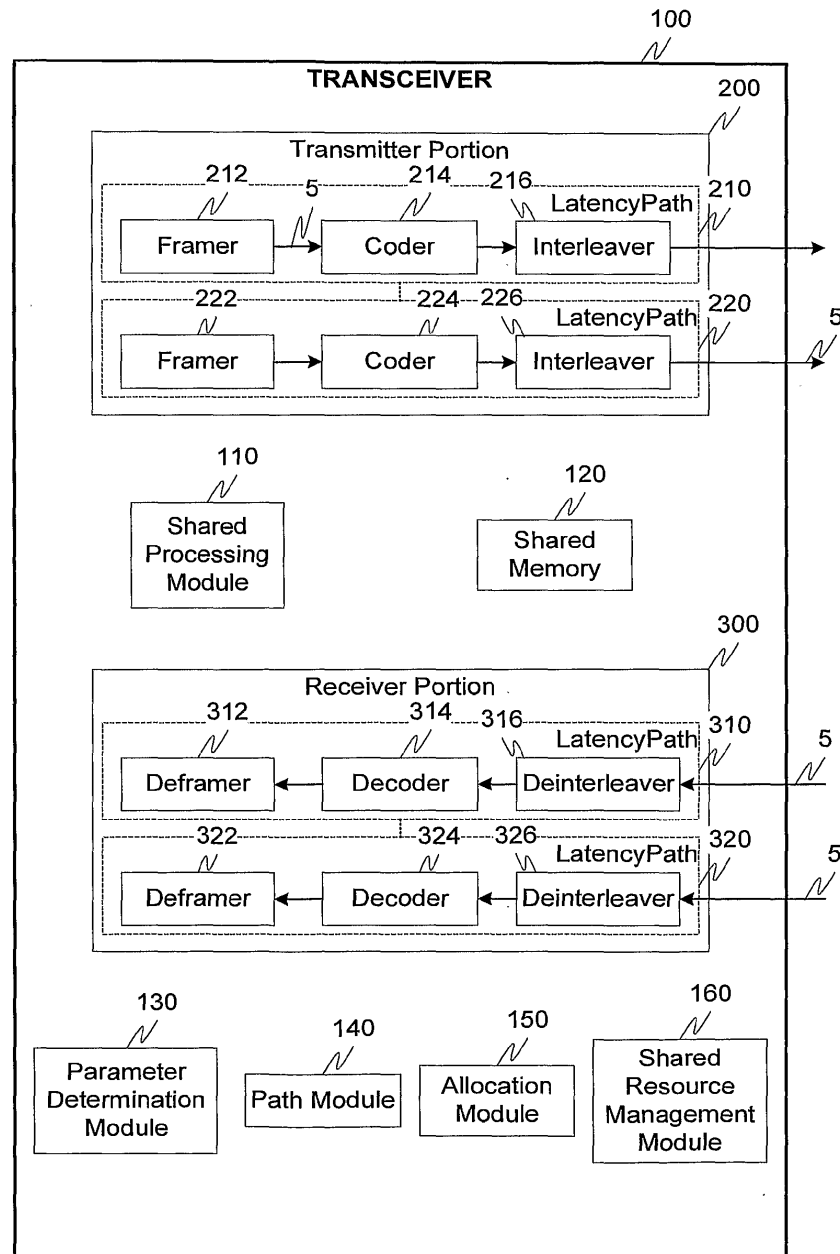


Fig. 1

2/3

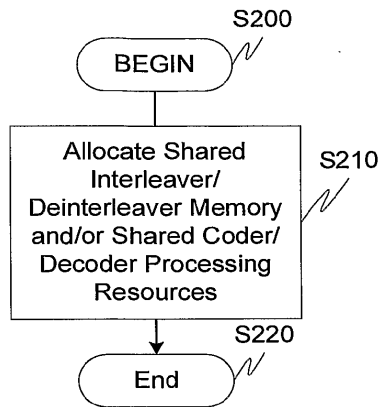


Fig. 2

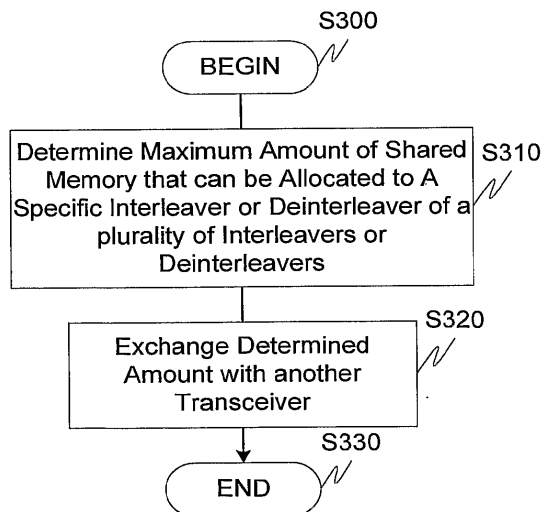


Fig. 3

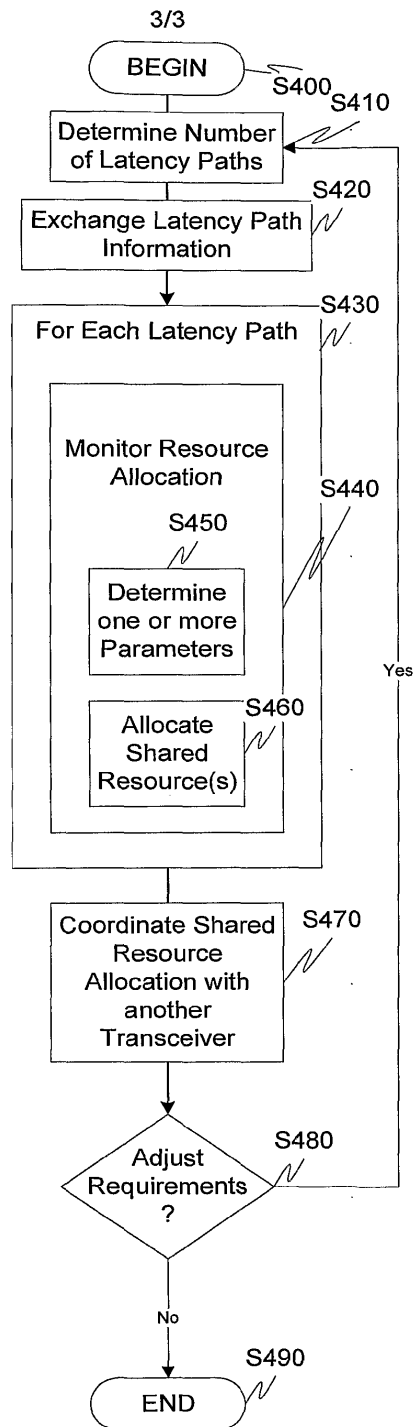


Fig. 4

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2005/036015

| <b>A. CLASSIFICATION OF SUBJECT MATTER</b><br>H04L1/00 H04L27/26                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                       |                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| According to International Patent Classification (IPC) or to both national classification and IPC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                       |                                                                  |
| <b>B. FIELDS SEARCHED</b><br>Minimum documentation searched (classification system followed by classification symbols)<br>H04L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                       |                                                                  |
| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                       |                                                                  |
| Electronic data base consulted during the international search (name of data base and, where practical, search terms used)<br>EPO-Internal, WPI Data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                       |                                                                  |
| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                       |                                                                  |
| Category*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                                    | Relevant to claim No.                                            |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US 6 707 822 B1 (FADAVI-ARDEKANI JALIL ET AL) 16 March 2004 (2004-03-16)<br>column 1, line 7 - column 2, line 59<br>column 3, line 5 - column 4, line 21<br>column 5, line 23 - column 7, line 33<br>column 8, line 4 - column 9, line 23<br>figure 2 | 1-45                                                             |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | WO 03/063060 A (BROADCOM CORPORATION) 31 July 2003 (2003-07-31)<br>page 1, line 5 - page 2, line 27<br>page 17, line 4 - page 18, line 25<br>figures 1,4<br>page 7, line 13 - page 9, line 16<br>-----<br>-/--                                        | 1-45                                                             |
| <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                       |                                                                  |
| * Special categories of cited documents :<br>*A* document defining the general state of the art which is not considered to be of particular relevance<br>*E* earlier document but published on or after the international filing date<br>*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)<br>*O* document referring to an oral disclosure, use, exhibition or other means<br>*P* document published prior to the international filing date but later than the priority date claimed<br>*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention<br>*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone<br>*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.<br>*& document member of the same patent family |                                                                                                                                                                                                                                                       |                                                                  |
| Date of the actual completion of the international search<br>18 January 2006                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                       | Date of mailing of the international search report<br>08/02/2006 |
| Name and mailing address of the ISA/<br>European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,<br>Fax: (+31-70) 340-3016                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                       | Authorized officer<br>Marzenke, M                                |

Form PCT/ISA/210 (second sheet) (April 2005)

page 1 of 2

## INTERNATIONAL SEARCH REPORT

International application No

PCT/US2005/036015

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                                                                                                                              | Relevant to claim No. |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| A         | US 6 337 877 B1 (COLE TERRY L ET AL)<br>8 January 2002 (2002-01-08)<br>column 3, line 21 - column 4, line 29<br>column 7, line 49 - column 8, line 67<br>figures 3,10<br>-----                                                                                                                                                                  | 1-45                  |
| A         | "SunSet xDSL: Prequalification of ADSL<br>Circuits with ATU-C Emulation"<br>2001, SUNRISE TELECOM INC., APPLICATION<br>SERIES , SAN JOSE, USA , XP002363272<br>Retrieved from the Internet:<br>URL:http://www.sunrisetelecom.com/technote<br>s/APP-xDSL-8B.pdf><br>'retrieved on 2006-01-17!<br>page 3, right-hand column, paragraph 1<br>----- | 1-45                  |

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

page 2 of 2



# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No  
PCT/US2005/036015

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date      |
|-------------------------------------------|---------------------|----------------------------|--------------------------|
| US 6707822                                | B1                  | 16-03-2004                 | NONE                     |
| WO 03063060                               | A                   | 31-07-2003                 | EP 1476978 A2 17-11-2004 |
| US 6337877                                | B1                  | 08-01-2002                 | EP 1125408 A1 22-08-2001 |
|                                           |                     | WO 0013387 A1              | 09-03-2000               |

Form PCT/ISA/210 (patent family annex) (April 2005)

| Electronic Acknowledgement Receipt   |                                                      |
|--------------------------------------|------------------------------------------------------|
| EFS ID:                              | 8181676                                              |
| Application Number:                  | 11246163                                             |
| International Application Number:    |                                                      |
| Confirmation Number:                 | 5478                                                 |
| Title of Invention:                  | Resource sharing in a telecommunications environment |
| First Named Inventor/Applicant Name: | Marcos C. Tzannes                                    |
| Customer Number:                     | 62574                                                |
| Filer:                               | Jason Vick/Carrie Steward                            |
| Filer Authorized By:                 | Jason Vick                                           |
| Attorney Docket Number:              | 5550-54                                              |
| Receipt Date:                        | 09-AUG-2010                                          |
| Filing Date:                         | 11-OCT-2005                                          |
| Time Stamp:                          | 16:36:45                                             |
| Application Type:                    | Utility under 35 USC 111(a)                          |

**Payment information:**

| Submitted with Payment | no                   |            |                                                      |                  |                  |
|------------------------|----------------------|------------|------------------------------------------------------|------------------|------------------|
| <b>File Listing:</b>   |                      |            |                                                      |                  |                  |
| Document Number        | Document Description | File Name  | File Size(Bytes)/<br>Message Digest                  | Multi Part /.zip | Pages (if appl.) |
| 1                      |                      | IDS_05.pdf | 439386<br>6008f873c9beab8ddc9adcaf36058d660a<br>aldd | yes              | 5                |

|                              | Multipart Description/PDF files in .zip description  |                                                |                                          |     |     |
|------------------------------|------------------------------------------------------|------------------------------------------------|------------------------------------------|-----|-----|
|                              | Document Description                                 |                                                | Start                                    | End |     |
|                              | Transmittal Letter                                   |                                                | 1                                        | 3   |     |
|                              | Information Disclosure Statement (IDS) Filed (SB/08) |                                                | 4                                        | 5   |     |
| Warnings:                    |                                                      |                                                |                                          |     |     |
| Information:                 |                                                      |                                                |                                          |     |     |
| 2                            | Foreign Reference                                    | EP1225735A1.pdf                                | 3319471                                  | no  | 30  |
|                              |                                                      |                                                | ab5e96001141a40a16f8e205e87ae59cad92e43  |     |     |
| Warnings:                    |                                                      |                                                |                                          |     |     |
| Information:                 |                                                      |                                                |                                          |     |     |
| 3                            | Foreign Reference                                    | EP1246409A1.pdf                                | 4522291                                  | no  | 38  |
|                              |                                                      |                                                | bfa232f471ba2a3d6ef7c8db62f3a099e58283e  |     |     |
| Warnings:                    |                                                      |                                                |                                          |     |     |
| Information:                 |                                                      |                                                |                                          |     |     |
| 4                            | Foreign Reference                                    | WO2006044227A1.pdf                             | 1310271                                  | no  | 37  |
|                              |                                                      |                                                | c7b3442410420f8d83cd5d28ad5a10bbfd968faa |     |     |
| Warnings:                    |                                                      |                                                |                                          |     |     |
| Information:                 |                                                      |                                                |                                          |     |     |
| 5                            | NPL Documents                                        | Shoji_WIRELESS_ACCESS_MET<br>HOD_TO_ENSURE.pdf | 1414514                                  | no  | 14  |
|                              |                                                      |                                                | e83281e015c9e4830594f9ec1232d0704b8e0314 |     |     |
| Warnings:                    |                                                      |                                                |                                          |     |     |
| Information:                 |                                                      |                                                |                                          |     |     |
| 6                            | NPL Documents                                        | ITU-<br>T_Recommendation_G_992_5.<br>pdf       | 3754491                                  | no  | 92  |
|                              |                                                      |                                                | 12d286f0ed80aef8c6897e43ec6a7ca902a6811d |     |     |
| Warnings:                    |                                                      |                                                |                                          |     |     |
| Information:                 |                                                      |                                                |                                          |     |     |
| 7                            | NPL Documents                                        | ITU-T_G_992_3.pdf                              | 7371505                                  | no  | 436 |
|                              |                                                      |                                                | eda53373e7c854022481a11df6724b43946e015d |     |     |
| Warnings:                    |                                                      |                                                |                                          |     |     |
| Information:                 |                                                      |                                                |                                          |     |     |
| 8                            | NPL Documents                                        | ITU_T_G993_2_PTO.pdf                           | 14564578                                 | no  | 252 |
|                              |                                                      |                                                | f7e8bb8a9ab0e59f6da3e2ac878c50b65e128c49 |     |     |
| Warnings:                    |                                                      |                                                |                                          |     |     |
| Information:                 |                                                      |                                                |                                          |     |     |
| Total Files Size (in bytes): |                                                      |                                                | 36696507                                 |     |     |

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

**New Applications Under 35 U.S.C. 111**

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

**National Stage of an International Application under 35 U.S.C. 371**

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

**New International Application Filed with the USPTO as a Receiving Office**

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

|                                  |   |                               |
|----------------------------------|---|-------------------------------|
| In Re the Application of:        | ) | Group Art Unit: 2447          |
| LUND, MICHAEL                    | ) | Confirmation No.: 5478        |
| Serial No.: 11/246,163           | ) | Examiner: Mark C. Pfizenmayer |
| Filed: October 11, 2005          | ) |                               |
| Atty. File No.: 5550-54          | ) | <u>SUPPLEMENTAL</u>           |
| Entitled: "RESOURCE SHARING IN A | ) | <u>INFORMATION DISCLOSURE</u> |
| TELECOMMUNICATIONS ENVIRONMENT"  | ) | <u>STATEMENT</u>              |
|                                  | ) | Electronically Submitted      |

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

The references cited on attached Form PTO-1449 are being called to the attention of the Examiner.

- ☒ Copies of the cited non-patent and/or foreign references are enclosed herewith.
- ☐ Copies of the cited U.S. patents and/or patent applications are enclosed herewith.
- ☒ Copies of the cited U.S. patents/patent application publications are not enclosed in accordance with 37 C.F.R. § 1.98(a).
- ☐ Copies of the cited references are not enclosed, in accordance with 37 C.F.R. § 1.98(d), because the references were cited by or submitted to the U.S. Patent and Trademark Office in prior application Serial No. \_\_\_\_\_ filed \_\_\_\_\_, which is relied upon for an earlier filing date under 35 U.S.C. § 120.
- ☐ To the best of applicants' belief, the pertinence of the foreign-language references are believed to be summarized in the attached English abstracts and in the figures, although applicants do not necessarily vouch for the accuracy of the translation.
- ☒ Examiner's attention is drawn to the following related applications:
- Serial No. 12/761,586 filed 04/16/10 (Attorney's Ref. No. 5550-54-CON)
  - Serial No. 12/295,828 filed 10/02/08 (Attorney's Ref. No. 5550-57-PUS)
  - Serial No. 12/760,728 filed 04/15/10 (Attorney's Ref. No. 5550-57-PUS-DIV)
  - Serial No. 12/783,758 filed 05/20/10 (Attorney's Ref. No. 5550-57-PUS-CON)

- Serial No. 12/783,765 filed 05/20/10 (Attorney's Ref. No. 5550-57-PUS-DIV-CON)

☒ Other: Examiner's attention is drawn to the resubmission of Citation No. 11. It was erroneously cited as WO2006/04427 on May 17, 2006. The correct citation is WO2006/044227.

Submission of the above information is not intended as an admission that any item is citable under the statutes or rules to support a rejection, that any item disclosed represents analogous art, or that those skilled in the art would refer to or recognize the pertinence of any reference without the benefit of hindsight, nor should an inference be drawn as to the pertinence of the references based on the order in which they are presented. Submission of this statement should not be taken as an indication that a search has been conducted, or that no better art exists.

It is respectfully requested that the cited information be expressly considered during the prosecution of this application and the references made of record therein.

#### FEES

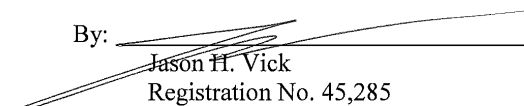
|                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | <p><b>37 CFR 1.97(b):</b> No fee is believed due in connection with this submission, because the information disclosure statement submitted herewith is satisfied by one of the following conditions ("X" indicates satisfaction):</p> <p><input type="checkbox"/> Within three months of the filing date of a national application other than a continued prosecution application under 37 CFR 1.53(d), or</p> <p><input type="checkbox"/> Within three months of the date of entry into the national stage of an international application as set forth in 37 CFR 1.491 or</p> <p><input type="checkbox"/> Before the mailing date of a first Office Action on the merits, or</p> <p><input checked="" type="checkbox"/> Before the mailing of a first Office action after the filing of a request for continued examination under 37 CFR 1.114.</p> <p>Although no fee is believed due, if any fee is deemed due in connection with this submission, please charge such fee to Deposit Account 19-1970.</p>                                            |
| <input type="checkbox"/>            | <p><b>37 CFR 1.97(e):</b> The information disclosure statement transmitted herewith is being filed after all the above conditions (37 CFR 1.97(b)), but before the mailing date of one of the following conditions:</p> <p>(1) a final action under 37 C.F.R. 1.113 or</p> <p>(2) a notice of allowance under 37 C.F.R. 1.311, or</p> <p>(3) an action that otherwise closes prosecution in the application.</p> <p>This Information Disclosure Statement is accompanied by:</p> <p><input type="checkbox"/> A Certification (below) as specified by 37 C.F.R. 1.97(e). Although no fee is believed due, if any fee is deemed due in connection with this submission, please charge such fee to Deposit Account 19-1970.</p> <p style="text-align: center;">OR</p> <p><input type="checkbox"/> Please charge Deposit Account 19-1970 in the amount of \$180.00 for the fee set forth in 37 C.F.R. 1.17(p) for submission of an information disclosure statement. Please credit any overpayment or charge any underpayment to Deposit Account 19-1970.</p> |
| <input type="checkbox"/>            | <p><b>37 CFR 1.97(d):</b> This Information Disclosure Statement is being submitted after the period specified in 37 CFR 1.97(c).</p> <p><input type="checkbox"/> This information Disclosure Statement includes a Certification (below) as specified by 37 C.F.R. 1.97(e)</p> <p style="text-align: center;">AND</p> <p><input type="checkbox"/> Applicants hereby requests consideration of the reference(s) disclosed herein. Please charge Deposit Account 19-1970 in the amount of \$180.00 under 37 C.F.R. 1.17(p). Please credit any overpayment or charge any underpayment to Deposit Account 19-1970. Election to pay the fee should not be taken as an indication that applicant(s) cannot execute a certification.</p>                                                                                                                                                                                                                                                                                                                          |

**Certification (37 C.F.R. 1.97(e))**  
(Applicable only if checked)

- ☐ The undersigned certifies that:
- ☐ Each item of information contained in this information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this statement. 37 C.F.R. 1.97(e)(1).
  - ☐ A copy of the communication from the foreign patent office is enclosed.
- OR
- ☐ No item of information contained in this information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the undersigned after making reasonable inquiry, no item of information contained in this Information Disclosure Statement was known to any individual designated in 37 C.F.R. 1.56(c) more than three months prior to the filing of this statement. 37 C.F.R. 1.97(e)(2).

Respectfully submitted,

SHERIDAN ROSS P.C.

By:   
Jason H. Vick  
Registration No. 45,285  
1560 Broadway, Suite 1200  
Denver, Colorado 80202-5141  
(303) 863-9700

Date: 9 Aug '16

PLUS Search Results for S/N 11246163, Searched Mon Jul 12 08:12:56 EDT 2010  
The Patent Linguistics Utility System (PLUS) is a USPTO automated search system for U.S. Patents from 1971 to the present PLUS is a query-by-example search system which produces a list of patents that are most closely related linguistically to the application searched. This search was prepared by the staff of the Scientific and Technical Information Center, SIRA.

|                |            |
|----------------|------------|
| 20060088054 99 | 5872920 52 |
| 20090300450 84 |            |
| 5781549 66     |            |
| 5572686 66     |            |
| 6065101 66     |            |
| 6374332 66     |            |
| 6411418 66     |            |
| 6988173 66     |            |
| 7069362 66     |            |
| 7085898 66     |            |
| 7111130 66     |            |
| 20040054857 66 |            |
| 20040076044 66 |            |
| 20040230726 66 |            |
| 20040230751 66 |            |
| 20040230752 66 |            |
| 20060184750 66 |            |
| 20060246907 63 |            |
| 5477539 55     |            |
| 20100167780 55 |            |
| 20080232444 53 |            |
| 6195334 52     |            |
| 5644576 52     |            |
| 5898904 52     |            |
| 6674971 52     |            |
| 6690934 52     |            |
| 20070043945 52 |            |
| 20070076655 52 |            |
| 20090239548 52 |            |
| 5524234 52     |            |
| 6138208 52     |            |
| 6185640 52     |            |
| 5307459 52     |            |
| 5337285 52     |            |
| 5412782 52     |            |
| 5485584 52     |            |
| 5498990 52     |            |
| 5526510 52     |            |
| 5537573 52     |            |
| 5613077 52     |            |
| 5649302 52     |            |
| 5713005 52     |            |
| 5729705 52     |            |
| 5734848 52     |            |
| 5737587 52     |            |
| 5805836 52     |            |
| 5815667 52     |            |
| 5831467 52     |            |
| 5844576 52     |            |



**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

|                                          |   |                           |
|------------------------------------------|---|---------------------------|
| In Re the Application of: Tzannes et al. | ) | Group Art Unit: 2447      |
| Application No.: 11/246,163              | ) | Examiner: Pfizenmayer, M. |
| Filed: October 11, 2005                  | ) | Confirmation No.: 5478    |
| Atty. File No.: 5550-54                  | ) |                           |

For: RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT

**SUPPLEMENTAL AMENDMENT AND RESPONSE**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

Applicants submit this Amendment and Response supplemental to the Amendment and Response and RCE filed December 17, 2009. Please credit any overpayment or charge any underpayment to Deposit Account No. 19-1970.

Please amend the above-identified patent application as follows:

**Amendments to the Claims** are shown in the listing of claims which begins on page 2 of this paper.

**Remarks** begin on page 5 of this paper.

**Amendments to the Claims:**

This listing of claims will replace all prior versions, and listings, of claims in the application:

**Listing of Claims:**

1. – 45. (Cancelled)

46. (Currently Amended) A method of allocating shared memory in a transceiver comprising:

transmitting or receiving, by the transceiver, a message during initialization indicating a maximum number of bytes of memory that can be allocated to an interleaver;

allocating, in the transceiver, a first number of bytes of a shared memory to the interleaver to interleave a first plurality of Reed Solomon (RS) coded data bytes for transmission at a first data rate; and

allocating, in the transceiver, a second number of bytes of the shared memory to a deinterleaver to deinterleave a second plurality of RS coded data bytes received at a second data rate,

wherein the allocated memory for the interleaver does not exceed the maximum number of bytes indicated in the message, and

wherein the shared memory is used to simultaneously interleave the first plurality of RS coded data bytes and deinterleave the second plurality of RS coded data bytes.

47. (Previously Presented) The method of claim 46, wherein the allocating is based on an impulse noise protection requirement.

48. (Previously Presented) The method of claim 46, wherein the allocating is based on a latency requirement.

49. (Previously Presented) The method of claim 46, wherein the allocating is based on a bit error rate requirement.

50. (Currently Amended) A method of allocating shared memory in a transceiver comprising:

transmitting or receiving, by the transceiver, a message during initialization indicating a maximum number of bytes of memory that can be allocated to a deinterleaver;

allocating, in the transceiver, a first number of bytes of a shared memory to an interleaver to interleave a first plurality of Reed Solomon (RS) coded data bytes for transmission at a first data rate; and

allocating, in the transceiver, a second number of bytes of the shared memory to the deinterleaver to deinterleave a second plurality of RS coded data bytes received at a second data rate,

wherein the allocated memory for the deinterleaver does not exceed the maximum number of bytes indicated in the message, and

wherein the shared memory is used to simultaneously interleave the first plurality of RS coded data bytes and deinterleave the second plurality of RS coded data bytes.

51. (Previously Presented) The method of claim 50, wherein the allocating is based on an impulse noise protection requirement.

52. (Previously Presented) The method of claim 50, wherein the allocating is based on a latency requirement.

53. (Previously Presented) The method of claim 50, wherein the allocating is based on a bit error rate requirement.

**REMARKS**

Applicants respectfully request reconsideration of this application as amended.

By this amendment, claims 46 and 50 have been amended to correct a typographical error. The combination of features in all the above claims is neither taught nor suggested by the cited reference.

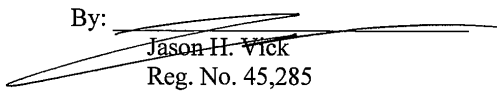
A Notice of Allowance is earnestly solicited.

The Commissioner is hereby authorized to charge to deposit account number 19-1970 any fees under 37 CFR § 1.16 and 1.17 that may be required by this paper and to credit any overpayment to that Account. If any extension of time is required in connection with the filing of this paper and has not been separately requested, such extension is hereby petitioned.

Respectfully submitted,

SHERIDAN ROSS P.C.

Date: 8 Mar '10

By:   
Jason H. Wick  
Reg. No. 45,285  
1560 Broadway, Suite 1200  
Denver, Colorado 80202  
Telephone: 303-863-9700

| Electronic Acknowledgement Receipt   |                                                      |
|--------------------------------------|------------------------------------------------------|
| EFS ID:                              | 7163129                                              |
| Application Number:                  | 11246163                                             |
| International Application Number:    |                                                      |
| Confirmation Number:                 | 5478                                                 |
| Title of Invention:                  | Resource sharing in a telecommunications environment |
| First Named Inventor/Applicant Name: | Marcos C. Tzannes                                    |
| Customer Number:                     | 62574                                                |
| Filer:                               | Jason Vick/Joanne Vos                                |
| Filer Authorized By:                 | Jason Vick                                           |
| Attorney Docket Number:              | 5550-54                                              |
| Receipt Date:                        | 08-MAR-2010                                          |
| Filing Date:                         | 11-OCT-2005                                          |
| Time Stamp:                          | 16:25:07                                             |
| Application Type:                    | Utility under 35 USC 111(a)                          |

**Payment information:**

|                        |    |
|------------------------|----|
| Submitted with Payment | no |
|------------------------|----|

**File Listing:**

| Document Number | Document Description | File Name                             | File Size(Bytes)/<br>Message Digest                              | Multi Part /.zip | Pages (if appl.) |
|-----------------|----------------------|---------------------------------------|------------------------------------------------------------------|------------------|------------------|
| 1               |                      | ThirdSupplementalAMENDwith<br>RCE.pdf | 45918<br><small>acc3dd5144f06e9617608d630bb6737f59a86027</small> | yes              | 5                |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Multipart Description/PDF files in .zip description |       |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|-------|-----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Document Description                                | Start | End |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Supplemental Response or Supplemental Amendment     | 1     | 1   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Claims                                              | 2     | 4   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Applicant Arguments/Remarks Made in an Amendment    | 5     | 5   |
| <b>Warnings:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                     |       |     |
| <b>Information:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                     |       |     |
| Total Files Size (in bytes):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                     | 45918 |     |
| <p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><b><u>New Applications Under 35 U.S.C. 111</u></b><br/>If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><b><u>National Stage of an International Application under 35 U.S.C. 371</u></b><br/>If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><b><u>New International Application Filed with the USPTO as a Receiving Office</u></b><br/>If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p> |                                                     |       |     |

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

| <b>PATENT APPLICATION FEE DETERMINATION RECORD</b><br>Substitute for Form PTO-875                                               |                                                                                          |                                                                                                                                                                                                                               |              |                                    | Application or Docket Number<br><b>11/246,163</b> |          | Filing Date<br><b>10/11/2005</b> |                         | <input type="checkbox"/> To be Mailed |          |                                                  |                     |
|---------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------------------------------------|---------------------------------------------------|----------|----------------------------------|-------------------------|---------------------------------------|----------|--------------------------------------------------|---------------------|
| <b>APPLICATION AS FILED – PART I</b>                                                                                            |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |          |                                                  |                     |
| (Column 1)                                                                                                                      |                                                                                          |                                                                                                                                                                                                                               | (Column 2)   |                                    | SMALL ENTITY <input type="checkbox"/> OR          |          |                                  | OTHER THAN SMALL ENTITY |                                       |          |                                                  |                     |
| FOR                                                                                                                             |                                                                                          | NUMBER FILED                                                                                                                                                                                                                  | NUMBER EXTRA |                                    | RATE (\$)                                         | FEE (\$) |                                  |                         | RATE (\$)                             | FEE (\$) |                                                  |                     |
| <input type="checkbox"/> BASIC FEE<br>(37 CFR 1.16(a), (b), or (c))                                                             |                                                                                          | N/A                                                                                                                                                                                                                           | N/A          |                                    | N/A                                               |          |                                  |                         | N/A                                   |          |                                                  |                     |
| <input type="checkbox"/> SEARCH FEE<br>(37 CFR 1.16(k), (l), or (m))                                                            |                                                                                          | N/A                                                                                                                                                                                                                           | N/A          |                                    | N/A                                               |          |                                  |                         | N/A                                   |          |                                                  |                     |
| <input type="checkbox"/> EXAMINATION FEE<br>(37 CFR 1.16(o), (p), or (q))                                                       |                                                                                          | N/A                                                                                                                                                                                                                           | N/A          |                                    | N/A                                               |          |                                  |                         | N/A                                   |          |                                                  |                     |
| TOTAL CLAIMS<br>(37 CFR 1.16(j))                                                                                                |                                                                                          | minus 20 =                                                                                                                                                                                                                    | *            |                                    | X \$ =                                            |          | OR                               |                         | X \$ =                                |          |                                                  |                     |
| INDEPENDENT CLAIMS<br>(37 CFR 1.16(h))                                                                                          |                                                                                          | minus 3 =                                                                                                                                                                                                                     | *            |                                    | X \$ =                                            |          |                                  |                         | X \$ =                                |          |                                                  |                     |
| <input type="checkbox"/> APPLICATION SIZE FEE<br>(37 CFR 1.16(s))                                                               |                                                                                          | If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s). |              |                                    |                                                   |          |                                  |                         |                                       |          |                                                  |                     |
| <input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))                                                      |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |          |                                                  |                     |
| * If the difference in column 1 is less than zero, enter "0" in column 2.                                                       |                                                                                          |                                                                                                                                                                                                                               |              |                                    | TOTAL                                             |          | OR                               |                         | TOTAL                                 |          |                                                  |                     |
| <b>APPLICATION AS AMENDED – PART II</b>                                                                                         |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |          |                                                  |                     |
| (Column 1)                                                                                                                      |                                                                                          |                                                                                                                                                                                                                               | (Column 2)   |                                    | (Column 3)                                        |          |                                  | SMALL ENTITY OR         |                                       |          | OTHER THAN SMALL ENTITY                          |                     |
| <b>AMENDMENT</b>                                                                                                                | <b>03/08/2010</b>                                                                        | CLAIMS REMAINING AFTER AMENDMENT                                                                                                                                                                                              |              | HIGHEST NUMBER PREVIOUSLY PAID FOR | PRESENT EXTRA                                     |          | RATE (\$)                        | ADDITIONAL FEE (\$)     |                                       |          | RATE (\$)                                        | ADDITIONAL FEE (\$) |
|                                                                                                                                 | Total (37 CFR 1.16(i))                                                                   | * 8                                                                                                                                                                                                                           | Minus        | ** 45                              | = 0                                               |          | X \$ =                           |                         | OR                                    |          | X \$52=                                          | 0                   |
|                                                                                                                                 | Independent (37 CFR 1.16(h))                                                             | * 2                                                                                                                                                                                                                           | Minus        | ***5                               | = 0                                               |          | X \$ =                           |                         | OR                                    |          | X \$220=                                         | 0                   |
|                                                                                                                                 | <input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))                           |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |          |                                                  |                     |
|                                                                                                                                 | <input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j)) |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |          |                                                  |                     |
|                                                                                                                                 |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  | TOTAL ADD'L FEE         |                                       | OR       |                                                  | TOTAL ADD'L FEE     |
| <b>AMENDMENT</b>                                                                                                                |                                                                                          | CLAIMS REMAINING AFTER AMENDMENT                                                                                                                                                                                              |              | HIGHEST NUMBER PREVIOUSLY PAID FOR | PRESENT EXTRA                                     |          | RATE (\$)                        | ADDITIONAL FEE (\$)     |                                       |          | RATE (\$)                                        | ADDITIONAL FEE (\$) |
|                                                                                                                                 | Total (37 CFR 1.16(i))                                                                   | *                                                                                                                                                                                                                             | Minus        | **                                 | =                                                 |          | X \$ =                           |                         | OR                                    |          | X \$ =                                           |                     |
|                                                                                                                                 | Independent (37 CFR 1.16(h))                                                             | *                                                                                                                                                                                                                             | Minus        | ***                                | =                                                 |          | X \$ =                           |                         | OR                                    |          | X \$ =                                           |                     |
|                                                                                                                                 | <input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))                           |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |          |                                                  |                     |
|                                                                                                                                 | <input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j)) |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |          |                                                  |                     |
|                                                                                                                                 |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  | TOTAL ADD'L FEE         |                                       | OR       |                                                  | TOTAL ADD'L FEE     |
| * If the entry in column 1 is less than the entry in column 2, write "0" in column 3.                                           |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |          | Legal Instrument Examiner:<br>/Halley D. Massey/ |                     |
| ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".                                       |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |          |                                                  |                     |
| *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".                                        |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |          |                                                  |                     |
| The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1. |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |          |                                                  |                     |

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.



**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

|                                          |   |                           |
|------------------------------------------|---|---------------------------|
| In Re the Application of: Tzannes et al. | ) | Group Art Unit: 2447      |
| Application No.: 11/246,163              | ) | Examiner: Pfizenmayer, M. |
| Filed: October 11, 2005                  | ) | Confirmation No.: 5478    |
| Atty. File No.: 5550-54                  | ) |                           |

For: RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT

**AMENDMENT AND RESPONSE**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

Applicants submit this Amendment and Response supplemental to the Amendment and Response and RCE filed December 17, 2009. Please credit any overpayment or charge any underpayment to Deposit Account No. 19-1970.

Please amend the above-identified patent application as follows:

**Amendments to the Claims** are shown in the listing of claims which begins on page 2 of this paper.

**Remarks** begin on page 4 of this paper.

**Amendments to the Claims:**

This listing of claims will replace all prior versions, and listings, of claims in the application:

**Listing of Claims:**

1. – 45. (Cancelled)

46. (Currently Amended) A method of allocating shared memory in a transceiver comprising:

transmitting or receiving, by the transceiver, a message during initialization indicating a maximum number of bytes of memory that can be allocated to an interleaver;

allocating, in the transceiver, a first number of bytes of a shared memory to an interleaver to interleave a first plurality of Reed Solomon (RS) coded data bytes for transmission at a first data rate; and

allocating, in the transceiver, a second number of bytes of the shared memory to a deinterleaver to deinterleave a second plurality RS coded data bytes received at a second data rate,

wherein the allocated memory for the interleaver does not exceed the maximum number of bytes indicated in the message, and

wherein the shared memory is used to simultaneously interleave the first plurality of RS coded data bytes and deinterleave the second plurality of RS coded data bytes.

47. (Previously Presented) The method of claim 46, wherein the allocating is based on an impulse noise protection requirement.

48. (Previously Presented) The method of claim 46, wherein the allocating is based on a latency requirement.

49. (Previously Presented) The method of claim 46, wherein the allocating is based on a bit error rate requirement.

50. (New) A method of allocating shared memory in a transceiver comprising:  
transmitting or receiving, by the transceiver, a message during initialization indicating a maximum number of bytes of memory that can be allocated to a deinterleaver;  
allocating, in the transceiver, a first number of bytes of a shared memory to an interleaver to interleave a first plurality of Reed Solomon (RS) coded data bytes for transmission at a first data rate; and  
allocating, in the transceiver, a second number of bytes of the shared memory to the deinterleaver to deinterleave a second plurality RS coded data bytes received at a second data rate,  
wherein the allocated memory for the deinterleaver does not exceed the maximum number of bytes indicated in the message, and  
wherein the shared memory is used to simultaneously interleave the first plurality of RS coded data bytes and deinterleave the second plurality of RS coded data bytes.

51. (New) The method of claim 50, wherein the allocating is based on an impulse noise protection requirement.

52. (New) The method of claim 50, wherein the allocating is based on a latency requirement.

53. (New) The method of claim 50, wherein the allocating is based on a bit error rate requirement.

**REMARKS**

Applicants respectfully request reconsideration of this application as amended.

By this amendment, claim 46 has been amended for antecedent basis, and new claims 50-53 are presented that more particularly claim a deinterleaver embodiment. The combination of features in all the above claims is neither taught nor suggested by the cited reference.

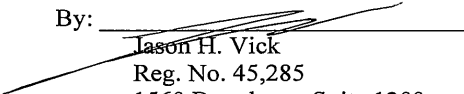
A Notice of Allowance is earnestly solicited.

The Commissioner is hereby authorized to charge to deposit account number 19-1970 any fees under 37 CFR § 1.16 and 1.17 that may be required by this paper and to credit any overpayment to that Account. If any extension of time is required in connection with the filing of this paper and has not been separately requested, such extension is hereby petitioned.

Respectfully submitted,

SHERIDAN ROSS P.C.

Date: 30 Dec '09

By:   
Jason H. Vick  
Reg. No. 45,285  
1560 Broadway, Suite 1200  
Denver, Colorado 80202  
Telephone: 303-863-9700

| Electronic Acknowledgement Receipt   |                                                      |
|--------------------------------------|------------------------------------------------------|
| EFS ID:                              | 6725317                                              |
| Application Number:                  | 11246163                                             |
| International Application Number:    |                                                      |
| Confirmation Number:                 | 5478                                                 |
| Title of Invention:                  | Resource sharing in a telecommunications environment |
| First Named Inventor/Applicant Name: | Marcos C. Tzannes                                    |
| Customer Number:                     | 62574                                                |
| Filer:                               | Jason Vick                                           |
| Filer Authorized By:                 |                                                      |
| Attorney Docket Number:              | 5550-54                                              |
| Receipt Date:                        | 30-DEC-2009                                          |
| Filing Date:                         | 11-OCT-2005                                          |
| Time Stamp:                          | 10:37:56                                             |
| Application Type:                    | Utility under 35 USC 111(a)                          |

**Payment information:**

| Submitted with Payment | no                   |                     |                                                    |                  |                  |
|------------------------|----------------------|---------------------|----------------------------------------------------|------------------|------------------|
| <b>File Listing:</b>   |                      |                     |                                                    |                  |                  |
| Document Number        | Document Description | File Name           | File Size(Bytes)/<br>Message Digest                | Multi Part /.zip | Pages (if appl.) |
| 1                      |                      | SupplementalAMD.pdf | 271859<br>fd69adefa822170cd8996dbb44eca1b17d39f368 | yes              | 5                |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Multipart Description/PDF files in .zip description |        |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|--------|-----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Document Description                                | Start  | End |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Amendment Submitted/Entered with Filing of CPA/RCE  | 1      | 1   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Claims                                              | 2      | 4   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Applicant Arguments/Remarks Made in an Amendment    | 5      | 5   |
| <b>Warnings:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                     |        |     |
| <b>Information:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                     |        |     |
| Total Files Size (in bytes):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                     | 271859 |     |
| <p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><b><u>New Applications Under 35 U.S.C. 111</u></b><br/>If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><b><u>National Stage of an International Application under 35 U.S.C. 371</u></b><br/>If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><b><u>New International Application Filed with the USPTO as a Receiving Office</u></b><br/>If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p> |                                                     |        |     |

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

| <b>PATENT APPLICATION FEE DETERMINATION RECORD</b><br>Substitute for Form PTO-875                                                                                                                                                                                                                                                                                                                                 |                                                                                          |                                                                                                                                                                                                                               |              |                                    | Application or Docket Number<br><b>11/246,163</b> |          | Filing Date<br><b>10/11/2005</b> |                         | <input type="checkbox"/> To be Mailed |           |                         |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------------------------------------|---------------------------------------------------|----------|----------------------------------|-------------------------|---------------------------------------|-----------|-------------------------|--|
| <b>APPLICATION AS FILED – PART I</b>                                                                                                                                                                                                                                                                                                                                                                              |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |           |                         |  |
| (Column 1)                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                          |                                                                                                                                                                                                                               | (Column 2)   |                                    | SMALL ENTITY <input type="checkbox"/> OR          |          |                                  | OTHER THAN SMALL ENTITY |                                       |           |                         |  |
| FOR                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                          | NUMBER FILED                                                                                                                                                                                                                  | NUMBER EXTRA |                                    | RATE (\$)                                         | FEE (\$) |                                  |                         | RATE (\$)                             | FEE (\$)  |                         |  |
| <input type="checkbox"/> BASIC FEE<br>(37 CFR 1.16(a), (b), or (c))                                                                                                                                                                                                                                                                                                                                               |                                                                                          | N/A                                                                                                                                                                                                                           | N/A          |                                    | N/A                                               |          |                                  |                         | N/A                                   |           |                         |  |
| <input type="checkbox"/> SEARCH FEE<br>(37 CFR 1.16(k), (l), or (m))                                                                                                                                                                                                                                                                                                                                              |                                                                                          | N/A                                                                                                                                                                                                                           | N/A          |                                    | N/A                                               |          |                                  |                         | N/A                                   |           |                         |  |
| <input type="checkbox"/> EXAMINATION FEE<br>(37 CFR 1.16(o), (p), or (q))                                                                                                                                                                                                                                                                                                                                         |                                                                                          | N/A                                                                                                                                                                                                                           | N/A          |                                    | N/A                                               |          |                                  |                         | N/A                                   |           |                         |  |
| TOTAL CLAIMS<br>(37 CFR 1.16(j))                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                          | minus 20 =                                                                                                                                                                                                                    | *            |                                    | X \$ =                                            |          | OR                               |                         | X \$ =                                |           |                         |  |
| INDEPENDENT CLAIMS<br>(37 CFR 1.16(h))                                                                                                                                                                                                                                                                                                                                                                            |                                                                                          | minus 3 =                                                                                                                                                                                                                     | *            |                                    | X \$ =                                            |          |                                  |                         | X \$ =                                |           |                         |  |
| <input type="checkbox"/> APPLICATION SIZE FEE<br>(37 CFR 1.16(s))                                                                                                                                                                                                                                                                                                                                                 |                                                                                          | If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s). |              |                                    |                                                   |          |                                  |                         |                                       |           |                         |  |
| <input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))                                                                                                                                                                                                                                                                                                                                        |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |           |                         |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                          |                                                                                                                                                                                                                               |              |                                    | TOTAL                                             |          |                                  |                         | TOTAL                                 |           |                         |  |
| * If the difference in column 1 is less than zero, enter "0" in column 2.                                                                                                                                                                                                                                                                                                                                         |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |           |                         |  |
| <b>APPLICATION AS AMENDED – PART II</b>                                                                                                                                                                                                                                                                                                                                                                           |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |           |                         |  |
| (Column 1)                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                          |                                                                                                                                                                                                                               | (Column 2)   |                                    | (Column 3)                                        |          |                                  | SMALL ENTITY OR         |                                       |           | OTHER THAN SMALL ENTITY |  |
| <b>AMENDMENT</b>                                                                                                                                                                                                                                                                                                                                                                                                  | <b>12/30/2009</b>                                                                        | CLAIMS REMAINING AFTER AMENDMENT                                                                                                                                                                                              |              | HIGHEST NUMBER PREVIOUSLY PAID FOR | PRESENT EXTRA                                     |          | RATE (\$)                        | ADDITIONAL FEE (\$)     |                                       | RATE (\$) | ADDITIONAL FEE (\$)     |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                   | Total (37 CFR 1.16(i))                                                                   | * 8                                                                                                                                                                                                                           | Minus        | ** 45                              | = 0                                               |          | X \$ =                           |                         | OR                                    |           | X \$52= 0               |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                   | Independent (37 CFR 1.16(h))                                                             | * 2                                                                                                                                                                                                                           | Minus        | ***5                               | = 0                                               |          | X \$ =                           |                         | OR                                    |           | X \$220= 0              |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                   | <input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))                           |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         | OR                                    |           |                         |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                   | <input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j)) |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         | OR                                    |           |                         |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          | TOTAL ADD'L FEE                  |                         | OR                                    |           | TOTAL ADD'L FEE 0       |  |
| <b>AMENDMENT</b>                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                          | CLAIMS REMAINING AFTER AMENDMENT                                                                                                                                                                                              |              | HIGHEST NUMBER PREVIOUSLY PAID FOR | PRESENT EXTRA                                     |          | RATE (\$)                        | ADDITIONAL FEE (\$)     |                                       | RATE (\$) | ADDITIONAL FEE (\$)     |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                   | Total (37 CFR 1.16(i))                                                                   | *                                                                                                                                                                                                                             | Minus        | **                                 | =                                                 |          | X \$ =                           |                         | OR                                    |           | X \$ =                  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                   | Independent (37 CFR 1.16(h))                                                             | *                                                                                                                                                                                                                             | Minus        | ***                                | =                                                 |          | X \$ =                           |                         | OR                                    |           | X \$ =                  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                   | <input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))                           |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         | OR                                    |           |                         |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                   | <input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j)) |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         | OR                                    |           |                         |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          | TOTAL ADD'L FEE                  |                         | OR                                    |           | TOTAL ADD'L FEE         |  |
| * If the entry in column 1 is less than the entry in column 2, write "0" in column 3.<br>** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".<br>*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".<br>The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1. |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |           |                         |  |
| Legal Instrument Examiner:<br>/SHARAIN MORELAND/                                                                                                                                                                                                                                                                                                                                                                  |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |           |                         |  |

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.



|                                                          |   |    |   |                          |                     |
|----------------------------------------------------------|---|----|---|--------------------------|---------------------|
| Substitute for form 1449A/PTO                            |   |    |   | <b>Complete if Known</b> |                     |
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b> |   |    |   | Application Number       | 11/246,163          |
|                                                          |   |    |   | Filing Date              | October 11, 2005    |
|                                                          |   |    |   | First Named Inventor     | LUND, MICHAEL       |
|                                                          |   |    |   | Art Unit                 | 2447                |
|                                                          |   |    |   | Examiner Name            | Mark C. Pfizenmayer |
| Sheet                                                    | 1 | of | 1 | Attorney Docket Number   | 5550-54             |

| U.S. PATENT DOCUMENTS |                       |                                                          |                             |                                                 |                                                                           |
|-----------------------|-----------------------|----------------------------------------------------------|-----------------------------|-------------------------------------------------|---------------------------------------------------------------------------|
| Examiner Initials*    | Cite No. <sup>1</sup> | Document Number Number-kind Code <sup>2</sup> (if known) | Publication Date MM-DD-YYYY | Name of Patentee of Applicant of Cited Document | Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear |

| FOREIGN PATENT DOCUMENTS |                       |                                                                                                             |                             |                                                 |                                                                           |                |
|--------------------------|-----------------------|-------------------------------------------------------------------------------------------------------------|-----------------------------|-------------------------------------------------|---------------------------------------------------------------------------|----------------|
| Examiner Initials*       | Cite No. <sup>1</sup> | Foreign Patent Document Country Code <sup>3</sup> ; Number <sup>4</sup> ; Kind Code <sup>5</sup> (if known) | Publication Date MM-DD-YYYY | Name of Patentee or Applicant of Cited Document | Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear | T <sup>6</sup> |

| OTHER ART (Including Author, Title, Date, Pertinent Pages, etc.) |                       |                                                                                                                                                                              |
|------------------------------------------------------------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Examiner Initials*                                               | Cite No. <sup>1</sup> |                                                                                                                                                                              |
|                                                                  | 1                     | Notification of the First Office Action (including translation) for Chinese Patent Application No. 200580032703, mailed September 25, 2009 (Attorney's Ref. No. 5550-54-PCN) |

|                    |  |                 |  |
|--------------------|--|-----------------|--|
| Examiner Signature |  | Date Considered |  |
|--------------------|--|-----------------|--|

\*EXAMINER: Initial if reference is considered, whether or not citation is in conformance and not considered. Include copy of this form with next communication to applicant.

| Electronic Acknowledgement Receipt          |                                                      |
|---------------------------------------------|------------------------------------------------------|
| <b>EFS ID:</b>                              | 6685276                                              |
| <b>Application Number:</b>                  | 11246163                                             |
| <b>International Application Number:</b>    |                                                      |
| <b>Confirmation Number:</b>                 | 5478                                                 |
| <b>Title of Invention:</b>                  | Resource sharing in a telecommunications environment |
| <b>First Named Inventor/Applicant Name:</b> | Marcos C. Tzannes                                    |
| <b>Customer Number:</b>                     | 62574                                                |
| <b>Filer:</b>                               | Jason Vick/Debra Kesner                              |
| <b>Filer Authorized By:</b>                 | Jason Vick                                           |
| <b>Attorney Docket Number:</b>              | 5550-54                                              |
| <b>Receipt Date:</b>                        | 22-DEC-2009                                          |
| <b>Filing Date:</b>                         | 11-OCT-2005                                          |
| <b>Time Stamp:</b>                          | 10:29:54                                             |
| <b>Application Type:</b>                    | Utility under 35 USC 111(a)                          |

**Payment information:**

|                        |    |
|------------------------|----|
| Submitted with Payment | no |
|------------------------|----|

**File Listing:**

| Document Number | Document Description | File Name  | File Size(Bytes)/<br>Message Digest                | Multi Part /.zip | Pages (if appl.) |
|-----------------|----------------------|------------|----------------------------------------------------|------------------|------------------|
| 1               |                      | IDS_04.pdf | 329785<br>8ace9be081d92983f3564986e3200f73bccd8d44 | yes              | 4                |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                            |                            |                                           |            |    |  |  |  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|----------------------------|-------------------------------------------|------------|----|--|--|--|--|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>Multipart Description/PDF files in .zip description</b> |                            |                                           |            |    |  |  |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>Document Description</b>                                |                            | <b>Start</b>                              | <b>End</b> |    |  |  |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Transmittal Letter                                         |                            | 1                                         | 3          |    |  |  |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Information Disclosure Statement (IDS) Filed (SB/08)       |                            | 4                                         | 4          |    |  |  |  |  |
| <b>Warnings:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                            |                            |                                           |            |    |  |  |  |  |
| <b>Information:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                            |                            |                                           |            |    |  |  |  |  |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | NPL Documents                                              | 5550-54-PCN_OA_9-25-09.pdf | 811648                                    | no         | 13 |  |  |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                            |                            | 107539c16c5da43ae8d11fe4d499847bfce058031 |            |    |  |  |  |  |
| <b>Warnings:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                            |                            |                                           |            |    |  |  |  |  |
| <b>Information:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                            |                            |                                           |            |    |  |  |  |  |
| <b>Total Files Size (in bytes):</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                            |                            | 1141433                                   |            |    |  |  |  |  |
| <p><b>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</b></p> <p><b><u>New Applications Under 35 U.S.C. 111</u></b><br/> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><b><u>National Stage of an International Application under 35 U.S.C. 371</u></b><br/> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><b><u>New International Application Filed with the USPTO as a Receiving Office</u></b><br/> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p> |                                                            |                            |                                           |            |    |  |  |  |  |

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

|                                  |   |                               |
|----------------------------------|---|-------------------------------|
| In Re the Application of:        | ) | Group Art Unit: 2447          |
| LUND, MICHAEL                    | ) | Confirmation No.: 5478        |
| Serial No.: 11/246,163           | ) | Examiner: Mark C. Pfizenmayer |
| Filed: October 11, 2005          | ) |                               |
| Atty. File No.: 5550-54          | ) | <u>INFORMATION DISCLOSURE</u> |
| Entitled: "RESOURCE SHARING IN A | ) | <u>STATEMENT</u>              |
| TELECOMMUNICATIONS ENVIRONMENT"  | ) | Electronically Submitted      |

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

The references cited on attached Form PTO-1449 are being called to the attention of the Examiner.

- ☒ Copies of the cited non-patent and/or foreign references are enclosed herewith.
- ☐ Copies of the cited U.S. patents and/or patent applications are enclosed herewith.
- ☐ Copies of the cited U.S. patents/patent application publications are not enclosed in accordance with 37 C.F.R. § 1.98(a).
- ☐ Copies of the cited references are not enclosed, in accordance with 37 C.F.R. § 1.98(d), because the references were cited by or submitted to the U.S. Patent and Trademark Office in prior application Serial No. \_\_\_\_\_ filed \_\_\_\_\_, which is relied upon for an earlier filing date under 35 U.S.C. § 120.
- ☐ To the best of applicants' belief, the pertinence of the foreign-language references are believed to be summarized in the attached English abstracts and in the figures, although applicants do not necessarily vouch for the accuracy of the translation.
- ☐ Examiner's attention is drawn to the following related applications:
- Serial No. \_\_\_\_\_ filed \_\_\_\_\_ (Attorney's Ref. No. \_\_\_\_\_)
- Serial No. \_\_\_\_\_ filed \_\_\_\_\_ (Attorney's Ref. No. \_\_\_\_\_)
- ☐ Other: \_\_\_\_\_

Submission of the above information is not intended as an admission that any item is citable under the statutes or rules to support a rejection, that any item disclosed represents analogous art, or that those skilled in the art would refer to or recognize the

pertinence of any reference without the benefit of hindsight, nor should an inference be drawn as to the pertinence of the references based on the order in which they are presented. Submission of this statement should not be taken as an indication that a search has been conducted, or that no better art exists.

It is respectfully requested that the cited information be expressly considered during the prosecution of this application and the references made of record therein.

#### FEES

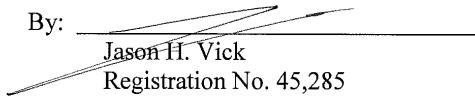
|                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | <p><b>37 CFR 1.97(b):</b> No fee is believed due in connection with this submission, because the information disclosure statement submitted herewith is satisfied by one of the following conditions ("X" indicates satisfaction):</p> <div style="margin-left: 20px;"> <input type="checkbox"/> Within three months of the filing date of a national application other than a continued prosecution application under 37 CFR 1.53(d), or<br/> <input type="checkbox"/> Within three months of the date of entry into the national stage of an international application as set forth in 37 CFR 1.491 or<br/> <input type="checkbox"/> Before the mailing date of a first Office Action on the merits, or<br/> <input checked="" type="checkbox"/> Before the mailing of a first Office action after the filing of a request for continued examination under 37 CFR 1.114.         </div> <p>Although no fee is believed due, if any fee is deemed due in connection with this submission, please charge such fee to Deposit Account 19-1970.</p>                                                                                               |
| <input type="checkbox"/>            | <p><b>37 CFR 1.97(c):</b> The information disclosure statement transmitted herewith is being filed after all the above conditions (37 CFR 1.97(b)), but before the mailing date of one of the following conditions:</p> <div style="margin-left: 20px;">           (1) a final action under 37 C.F.R. 1.113 or<br/>           (2) a notice of allowance under 37 C.F.R. 1.311, or<br/>           (3) an action that otherwise closes prosecution in the application.         </div> <p>This Information Disclosure Statement is accompanied by:</p> <div style="margin-left: 20px;"> <input type="checkbox"/> A Certification (below) as specified by 37 C.F.R. 1.97(e). Although no fee is believed due, if any fee is deemed due in connection with this submission, please charge such fee to Deposit Account 19-1970.<br/>           OR<br/> <input type="checkbox"/> Please charge Deposit Account 19-1970 in the amount of \$180.00 for the fee set forth in 37 C.F.R. 1.17(p) for submission of an information disclosure statement. Please credit any overpayment or charge any underpayment to Deposit Account 19-1970.         </div> |
| <input type="checkbox"/>            | <p><b>37 CFR 1.97(d):</b> This Information Disclosure Statement is being submitted after the period specified in 37 CFR 1.97(c).</p> <div style="margin-left: 20px;"> <input type="checkbox"/> This information Disclosure Statement includes a Certification (below) as specified by 37 C.F.R. 1.97(e)<br/>           AND<br/> <input type="checkbox"/> Applicants hereby requests consideration of the reference(s) disclosed herein. Please charge Deposit Account 19-1970 in the amount of \$180.00 under 37 C.F.R. 1.17(p). Please credit any overpayment or charge any underpayment to Deposit Account 19-1970. Election to pay the fee should not be taken as an indication that applicant(s) cannot execute a certification.         </div>                                                                                                                                                                                                                                                                                                                                                                                             |

**Certification (37 C.F.R. 1.97(e))**  
(Applicable only if checked)

- ☐ The undersigned certifies that:
- ☐ Each item of information contained in this information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this statement. 37 C.F.R. 1.97(e)(1).
  - ☐ A copy of the communication from the foreign patent office is enclosed.
- OR
- ☐ No item of information contained in this information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the undersigned after making reasonable inquiry, no item of information contained in this Information Disclosure Statement was known to any individual designated in 37 C.F.R. 1.56(c) more than three months prior to the filing of this statement. 37 C.F.R. 1.97(e)(2).

Respectfully submitted,

SHERIDAN ROSS P.C.

By:   
Jason H. Vick  
Registration No. 45,285  
1560 Broadway, Suite 1200  
Denver, Colorado 80202-5141  
(303) 863-9700

Date: 22 Dec '09

Doc code: RCEX

Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (07-09)

Approved for use through 07/31/2012. OMB 0851-0031  
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

| <b>REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL</b><br><b>(Submitted Only via EFS-Web)</b>                                                                                                                                                                                                                                                                       |                   |             |            |                               |                   |          |      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------|------------|-------------------------------|-------------------|----------|------|
| Application Number                                                                                                                                                                                                                                                                                                                                                    | 11246163          | Filing Date | 2005-10-11 | Docket Number (if applicable) | 5550-54           | Art Unit | 2447 |
| First Named Inventor                                                                                                                                                                                                                                                                                                                                                  | Marcos C. Tzannes |             |            | Examiner Name                 | Pfizenmayer, Mark |          |      |
| <b>This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.</b><br>Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV |                   |             |            |                               |                   |          |      |
| SUBMISSION REQUIRED UNDER 37 CFR 1.114                                                                                                                                                                                                                                                                                                                                |                   |             |            |                               |                   |          |      |
| Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).                 |                   |             |            |                               |                   |          |      |
| <input type="checkbox"/> Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.                                                                                                                                                         |                   |             |            |                               |                   |          |      |
| <input type="checkbox"/> Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____                                                                                                                                                                                                                                                          |                   |             |            |                               |                   |          |      |
| <input type="checkbox"/> Other _____                                                                                                                                                                                                                                                                                                                                  |                   |             |            |                               |                   |          |      |
| <input checked="" type="checkbox"/> Enclosed                                                                                                                                                                                                                                                                                                                          |                   |             |            |                               |                   |          |      |
| <input checked="" type="checkbox"/> Amendment/Reply                                                                                                                                                                                                                                                                                                                   |                   |             |            |                               |                   |          |      |
| <input type="checkbox"/> Information Disclosure Statement (IDS)                                                                                                                                                                                                                                                                                                       |                   |             |            |                               |                   |          |      |
| <input type="checkbox"/> Affidavit(s)/ Declaration(s)                                                                                                                                                                                                                                                                                                                 |                   |             |            |                               |                   |          |      |
| <input type="checkbox"/> Other _____                                                                                                                                                                                                                                                                                                                                  |                   |             |            |                               |                   |          |      |
| MISCELLANEOUS                                                                                                                                                                                                                                                                                                                                                         |                   |             |            |                               |                   |          |      |
| <input type="checkbox"/> Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____<br>(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)                                                                                                                              |                   |             |            |                               |                   |          |      |
| <input type="checkbox"/> Other _____                                                                                                                                                                                                                                                                                                                                  |                   |             |            |                               |                   |          |      |
| FEES                                                                                                                                                                                                                                                                                                                                                                  |                   |             |            |                               |                   |          |      |
| <input checked="" type="checkbox"/> <b>The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.</b><br>The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to<br>Deposit Account No 191970                                                                                                   |                   |             |            |                               |                   |          |      |
| SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED                                                                                                                                                                                                                                                                                                                   |                   |             |            |                               |                   |          |      |
| <input checked="" type="checkbox"/> Patent Practitioner Signature                                                                                                                                                                                                                                                                                                     |                   |             |            |                               |                   |          |      |
| <input type="checkbox"/> Applicant Signature                                                                                                                                                                                                                                                                                                                          |                   |             |            |                               |                   |          |      |

EFS - Web 2.1.15

Doc code: RCEX

Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (07-09)

Approved for use through 07/31/2012. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

| Signature of Registered U.S. Patent Practitioner |                 |                     |            |
|--------------------------------------------------|-----------------|---------------------|------------|
| Signature                                        | /Jason H. Vick/ | Date (YYYY-MM-DD)   | 2009-12-17 |
| Name                                             | Jason H. Vick   | Registration Number | 45285      |

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450.

*If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.*



## Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

| Electronic Patent Application Fee Transmittal |          |                                                      |        |                      |
|-----------------------------------------------|----------|------------------------------------------------------|--------|----------------------|
| <b>Application Number:</b>                    |          | 11246163                                             |        |                      |
| <b>Filing Date:</b>                           |          | 11-Oct-2005                                          |        |                      |
| <b>Title of Invention:</b>                    |          | Resource sharing in a telecommunications environment |        |                      |
| <b>First Named Inventor/Applicant Name:</b>   |          | Marcos C. Tzannes                                    |        |                      |
| <b>Filer:</b>                                 |          | Jason Vick/Joanne Vos                                |        |                      |
| <b>Attorney Docket Number:</b>                |          | 5550-54                                              |        |                      |
| Filed as Large Entity                         |          |                                                      |        |                      |
| Utility under 35 USC 111(a) Filing Fees       |          |                                                      |        |                      |
| Description                                   | Fee Code | Quantity                                             | Amount | Sub-Total in USD(\$) |
| <b>Basic Filing:</b>                          |          |                                                      |        |                      |
| <b>Pages:</b>                                 |          |                                                      |        |                      |
| <b>Claims:</b>                                |          |                                                      |        |                      |
| <b>Miscellaneous-Filing:</b>                  |          |                                                      |        |                      |
| <b>Petition:</b>                              |          |                                                      |        |                      |
| <b>Patent-Appeals-and-Interference:</b>       |          |                                                      |        |                      |
| <b>Post-Allowance-and-Post-Issuance:</b>      |          |                                                      |        |                      |
| <b>Extension-of-Time:</b>                     |          |                                                      |        |                      |

| Description                       | Fee Code | Quantity | Amount | Sub-Total in USD(\$) |
|-----------------------------------|----------|----------|--------|----------------------|
| <b>Miscellaneous:</b>             |          |          |        |                      |
| Request for continued examination | 1801     | 1        | 810    | 810                  |
| <b>Total in USD (\$)</b>          |          |          |        | <b>810</b>           |

| Electronic Acknowledgement Receipt          |                                                      |
|---------------------------------------------|------------------------------------------------------|
| <b>EFS ID:</b>                              | 6661680                                              |
| <b>Application Number:</b>                  | 11246163                                             |
| <b>International Application Number:</b>    |                                                      |
| <b>Confirmation Number:</b>                 | 5478                                                 |
| <b>Title of Invention:</b>                  | Resource sharing in a telecommunications environment |
| <b>First Named Inventor/Applicant Name:</b> | Marcos C. Tzannes                                    |
| <b>Customer Number:</b>                     | 62574                                                |
| <b>Filer:</b>                               | Jason Vick/Joanne Vos                                |
| <b>Filer Authorized By:</b>                 | Jason Vick                                           |
| <b>Attorney Docket Number:</b>              | 5550-54                                              |
| <b>Receipt Date:</b>                        | 17-DEC-2009                                          |
| <b>Filing Date:</b>                         | 11-OCT-2005                                          |
| <b>Time Stamp:</b>                          | 17:09:02                                             |
| <b>Application Type:</b>                    | Utility under 35 USC 111(a)                          |

### Payment information:

|                                                                                                                                                                                                                                                                                                                                                                                          |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Submitted with Payment                                                                                                                                                                                                                                                                                                                                                                   | yes             |
| Payment Type                                                                                                                                                                                                                                                                                                                                                                             | Deposit Account |
| Payment was successfully received in RAM                                                                                                                                                                                                                                                                                                                                                 | \$810           |
| RAM confirmation Number                                                                                                                                                                                                                                                                                                                                                                  | 4244            |
| Deposit Account                                                                                                                                                                                                                                                                                                                                                                          | 191970          |
| Authorized User                                                                                                                                                                                                                                                                                                                                                                          |                 |
| <p>The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:</p> <p>Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)</p> <p>Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)</p> |                 |

|                                                                                                   |                                                     |                  |                                                     |                  |                  |
|---------------------------------------------------------------------------------------------------|-----------------------------------------------------|------------------|-----------------------------------------------------|------------------|------------------|
| Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)           |                                                     |                  |                                                     |                  |                  |
| Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)             |                                                     |                  |                                                     |                  |                  |
| Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges) |                                                     |                  |                                                     |                  |                  |
| File Listing:                                                                                     |                                                     |                  |                                                     |                  |                  |
| Document Number                                                                                   | Document Description                                | File Name        | File Size(Bytes)/ Message Digest                    | Multi Part /.zip | Pages (if appl.) |
| 1                                                                                                 |                                                     | AMENDwithRCE.pdf | 232157<br>c7e9ebb3c79906fa7182350604499aa9fe7b576e9 | yes              | 4                |
|                                                                                                   | Multipart Description/PDF files in .zip description |                  |                                                     |                  |                  |
|                                                                                                   | Document Description                                |                  | Start                                               | End              |                  |
|                                                                                                   | Amendment After Final                               |                  | 1                                                   | 1                |                  |
|                                                                                                   | Claims                                              |                  | 2                                                   | 3                |                  |
|                                                                                                   | Applicant Arguments/Remarks Made in an Amendment    |                  | 4                                                   | 4                |                  |
| Warnings:                                                                                         |                                                     |                  |                                                     |                  |                  |
| Information:                                                                                      |                                                     |                  |                                                     |                  |                  |
| 2                                                                                                 | Request for Continued Examination (RCE)             | RCE.pdf          | 697433<br>af669f212339d50f0ac5434138497baf16299a3e  | no               | 3                |
| Warnings:                                                                                         |                                                     |                  |                                                     |                  |                  |
| Information:                                                                                      |                                                     |                  |                                                     |                  |                  |
| 3                                                                                                 | Fee Worksheet (PTO-875)                             | fee-info.pdf     | 29818<br>8fc24dae60487e5945f726cc0c0a8e741fb6dd38   | no               | 2                |
| Warnings:                                                                                         |                                                     |                  |                                                     |                  |                  |
| Information:                                                                                      |                                                     |                  |                                                     |                  |                  |
| Total Files Size (in bytes):                                                                      |                                                     |                  | 959408                                              |                  |                  |

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

**New Applications Under 35 U.S.C. 111**

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

**National Stage of an International Application under 35 U.S.C. 371**

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

**New International Application Filed with the USPTO as a Receiving Office**

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

|                                          |   |                           |
|------------------------------------------|---|---------------------------|
| In Re the Application of: Tzannes et al. | ) | Group Art Unit: 2447      |
| Application No.: 11/246,163              | ) | Examiner: Pfizenmayer, M. |
| Filed: October 11, 2005                  | ) | Confirmation No.: 5478    |
| Atty. File No.: 5550-54                  | ) |                           |

For: RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT

**AMENDMENT AND RESPONSE**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

Applicants submit this Amendment and Response to address the Final Office Action having a mailing date of December 9, 2009. Please credit any overpayment or charge any underpayment to Deposit Account No. 19-1970.

Please amend the above-identified patent application as follows:

**Amendments to the Claims** are shown in the listing of claims which begins on page 2 of this paper.

**Remarks** begin on page 4 of this paper.

**Amendments to the Claims:**

This listing of claims will replace all prior versions, and listings, of claims in the application:

**Listing of Claims:**

1. – 45. (Cancelled)

46. (New) A method of allocating shared memory in a transceiver comprising:

transmitting or receiving, by the transceiver, a message during initialization indicating a maximum number of bytes of memory that can be allocated to an interleaver;

allocating, in the transceiver, a first number of bytes of a shared memory to an interleaver to interleave a first plurality of Reed Solomon (RS) coded data bytes for transmission at a first data rate; and

allocating, in the transceiver, a second number of bytes of the shared memory to a deinterleaver to deinterleave a second plurality RS coded data bytes received at a second data rate,

wherein the allocated memory for the interleaver does not exceed the maximum number of bytes indicated in the message, and

wherein the shared memory is used to simultaneously interleave the first plurality of RS coded data bytes and deinterleave the second plurality of RS coded data bytes.

47. (New) The method of claim 46, wherein the allocating is based on an impulse noise protection requirement.



48. (New) The method of claim 46, wherein the allocating is based on a latency requirement.

49. (New) The method of claim 46, wherein the allocating is based on a bit error rate requirement.

### REMARKS

Applicants respectfully request reconsideration of this application as amended.

By this amendment, the pending claims have been cancelled without prejudice or disclaimer in favor of the newly presented claims.

Applicants would like to thank Examiners Pfizenmayer and Bruckhart for the courtesies extended during the December 8, 2009 Personal Interview and during the subsequent email exchanges. During the interview, the general operation of the invention was discussed and it was agreed that the proposed amendments to the claims "were a step in the right direction." The Examiner also suggested additional features for the claim.

By this amendment, new claim 46 is presented that more particularly claims certain aspects of the invention. The combination of features in claim 46 is neither taught nor suggested by the cited reference.

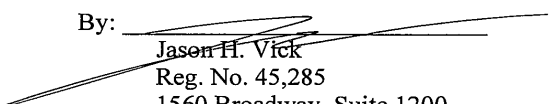
In that all objections are rejections are moot, and the pending claims are patentably distinguishable from the reference, a Notice of Allowance is earnestly solicited.

The Commissioner is hereby authorized to charge to deposit account number 19-1970 any fees under 37 CFR § 1.16 and 1.17 that may be required by this paper and to credit any overpayment to that Account. If any extension of time is required in connection with the filing of this paper and has not been separately requested, such extension is hereby petitioned.

Respectfully submitted,

SHERIDAN ROSS P.C.

Date: 17 Dec 09

By:   
Jason H. Vick  
Reg. No. 45,285  
1560 Broadway, Suite 1200  
Denver, Colorado 80202  
Telephone: 303-863-9700

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

| <b>PATENT APPLICATION FEE DETERMINATION RECORD</b><br>Substitute for Form PTO-875                                                                                                                                                                                                                                                                                                                                                    |                                                                                          |                                                                                                                                                                                                                               |              |                                    | Application or Docket Number<br><b>11/246,163</b> |          | Filing Date<br><b>10/11/2005</b> |                         | <input type="checkbox"/> To be Mailed |          |                         |                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------------------------------------|---------------------------------------------------|----------|----------------------------------|-------------------------|---------------------------------------|----------|-------------------------|---------------------|
| <b>APPLICATION AS FILED – PART I</b>                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |          |                         |                     |
| (Column 1)                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                          |                                                                                                                                                                                                                               | (Column 2)   |                                    | SMALL ENTITY <input type="checkbox"/> OR          |          |                                  | OTHER THAN SMALL ENTITY |                                       |          |                         |                     |
| FOR                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                          | NUMBER FILED                                                                                                                                                                                                                  | NUMBER EXTRA |                                    | RATE (\$)                                         | FEE (\$) |                                  |                         | RATE (\$)                             | FEE (\$) |                         |                     |
| <input type="checkbox"/> BASIC FEE<br>(37 CFR 1.16(a), (b), or (c))                                                                                                                                                                                                                                                                                                                                                                  |                                                                                          | N/A                                                                                                                                                                                                                           | N/A          |                                    | N/A                                               |          |                                  |                         | N/A                                   |          |                         |                     |
| <input type="checkbox"/> SEARCH FEE<br>(37 CFR 1.16(k), (l), or (m))                                                                                                                                                                                                                                                                                                                                                                 |                                                                                          | N/A                                                                                                                                                                                                                           | N/A          |                                    | N/A                                               |          |                                  |                         | N/A                                   |          |                         |                     |
| <input type="checkbox"/> EXAMINATION FEE<br>(37 CFR 1.16(o), (p), or (q))                                                                                                                                                                                                                                                                                                                                                            |                                                                                          | N/A                                                                                                                                                                                                                           | N/A          |                                    | N/A                                               |          |                                  |                         | N/A                                   |          |                         |                     |
| TOTAL CLAIMS<br>(37 CFR 1.16(j))                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                          | minus 20 =                                                                                                                                                                                                                    | *            |                                    | X \$ =                                            |          | OR                               |                         | X \$ =                                |          |                         |                     |
| INDEPENDENT CLAIMS<br>(37 CFR 1.16(h))                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                          | minus 3 =                                                                                                                                                                                                                     | *            |                                    | X \$ =                                            |          |                                  |                         | X \$ =                                |          |                         |                     |
| <input type="checkbox"/> APPLICATION SIZE FEE<br>(37 CFR 1.16(s))                                                                                                                                                                                                                                                                                                                                                                    |                                                                                          | If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s). |              |                                    |                                                   |          |                                  |                         |                                       |          |                         |                     |
| <input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))                                                                                                                                                                                                                                                                                                                                                           |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |          |                         |                     |
| * If the difference in column 1 is less than zero, enter "0" in column 2.                                                                                                                                                                                                                                                                                                                                                            |                                                                                          |                                                                                                                                                                                                                               |              |                                    | TOTAL                                             |          |                                  |                         | TOTAL                                 |          |                         |                     |
| <b>APPLICATION AS AMENDED – PART II</b>                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |          |                         |                     |
| (Column 1)                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                          |                                                                                                                                                                                                                               | (Column 2)   |                                    | (Column 3)                                        |          |                                  | SMALL ENTITY OR         |                                       |          | OTHER THAN SMALL ENTITY |                     |
| <b>AMENDMENT</b>                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>12/17/2009</b>                                                                        | CLAIMS REMAINING AFTER AMENDMENT                                                                                                                                                                                              |              | HIGHEST NUMBER PREVIOUSLY PAID FOR | PRESENT EXTRA                                     |          | RATE (\$)                        | ADDITIONAL FEE (\$)     |                                       |          | RATE (\$)               | ADDITIONAL FEE (\$) |
|                                                                                                                                                                                                                                                                                                                                                                                                                                      | Total (37 CFR 1.16(i))                                                                   | * 4                                                                                                                                                                                                                           | Minus        | ** 45                              | = 0                                               |          | X \$ =                           |                         | OR                                    |          | X \$52=                 | 0                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                      | Independent (37 CFR 1.16(h))                                                             | * 1                                                                                                                                                                                                                           | Minus        | ***5                               | = 0                                               |          | X \$ =                           |                         | OR                                    |          | X \$220=                | 0                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                      | <input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))                           |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |          |                         |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                      | <input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j)) |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |          |                         |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  | TOTAL ADD'L FEE         |                                       | OR       |                         | TOTAL ADD'L FEE     |
| <b>AMENDMENT</b>                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                          | CLAIMS REMAINING AFTER AMENDMENT                                                                                                                                                                                              |              | HIGHEST NUMBER PREVIOUSLY PAID FOR | PRESENT EXTRA                                     |          | RATE (\$)                        | ADDITIONAL FEE (\$)     |                                       |          | RATE (\$)               | ADDITIONAL FEE (\$) |
|                                                                                                                                                                                                                                                                                                                                                                                                                                      | Total (37 CFR 1.16(i))                                                                   | *                                                                                                                                                                                                                             | Minus        | **                                 | =                                                 |          | X \$ =                           |                         | OR                                    |          | X \$ =                  |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                      | Independent (37 CFR 1.16(h))                                                             | *                                                                                                                                                                                                                             | Minus        | ***                                | =                                                 |          | X \$ =                           |                         | OR                                    |          | X \$ =                  |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                      | <input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))                           |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |          |                         |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                      | <input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j)) |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |          |                         |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  | TOTAL ADD'L FEE         |                                       | OR       |                         | TOTAL ADD'L FEE     |
| <p>* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.</p> <p>** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".</p> <p>*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".</p> <p>The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.</p> |                                                                                          |                                                                                                                                                                                                                               |              |                                    |                                                   |          |                                  |                         |                                       |          |                         |                     |

Legal Instrument Examiner:  
/Fennell A. Pearlie/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

| APPLICATION NO.   | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-------------------|-------------|----------------------|---------------------|------------------|
| 11/246,163        | 10/11/2005  | Marcos C. Tzannes    | 5550-54             | 5478             |
| 62574             | 7590        | 12/16/2009           | EXAMINER            |                  |
| Jason H. Vick     |             |                      | PFIZENMAYER, MARK C |                  |
| Sheridan Ross, PC |             |                      | ART UNIT            | PAPER NUMBER     |
| Suite # 1200      |             |                      | 2447                |                  |
| 1560 Broadway     |             |                      | NOTIFICATION DATE   | DELIVERY MODE    |
| Denver, CO 80202  |             |                      | 12/16/2009          | ELECTRONIC       |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

jvick@sheridanross.com

|                          |                        |                     |  |
|--------------------------|------------------------|---------------------|--|
| <b>Interview Summary</b> | <b>Application No.</b> | <b>Applicant(s)</b> |  |
|                          | 11/246,163             | TZANNES ET AL.      |  |
|                          | <b>Examiner</b>        | <b>Art Unit</b>     |  |
|                          | BENJAMIN R. BRUCKART   | 2446                |  |

All participants (applicant, applicant's representative, PTO personnel):

(1) BENJAMIN R. BRUCKART. (3) Jason H Vick, Reg. No. 45, 285.

(2) Pfizenmayer, Mark. (4) Inventor Marcos Tzannes.

Date of Interview: 08 December 2009.

Type: a) ☐ Telephonic b) ☐ Video Conference  
c) ☒ Personal [copy given to: 1) ☒ applicant 2) ☐ applicant's representative]

Exhibit shown or demonstration conducted: d) ☐ Yes e) ☐ No.  
If Yes, brief description: \_\_\_\_\_.

Claim(s) discussed: 1.

Identification of prior art discussed: N/A.

Agreement with respect to the claims f) ☐ was reached. g) ☒ was not reached. h) ☐ N/A.

Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: See Continuation Sheet.

(A fuller description, if necessary, and a copy of the amendments which the examiner agreed would render the claims allowable, if available, must be attached. Also, where no copy of the amendments that would render the claims allowable is available, a summary thereof must be attached.)

THE FORMAL WRITTEN REPLY TO THE LAST OFFICE ACTION MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a reply to the last Office action has already been filed, APPLICANT IS GIVEN A NON-EXTENDABLE PERIOD OF THE LONGER OF ONE MONTH OR THIRTY DAYS FROM THIS INTERVIEW DATE, OR THE MAILING DATE OF THIS INTERVIEW SUMMARY FORM, WHICHEVER IS LATER, TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW. See Summary of Record of Interview requirements on reverse side or on attached sheet.

|                                                          |  |
|----------------------------------------------------------|--|
| /Benjamin R Bruckart/<br>Primary Examiner, Art Unit 2446 |  |
|----------------------------------------------------------|--|

## Summary of Record of Interview Requirements

### Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record

A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

#### Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews Paragraph (b)

In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

37 CFR §1.2 Business to be transacted in writing.

All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:

- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:

- 1) A brief description of the nature of any exhibit shown or any demonstration conducted,
- 2) an identification of the claims discussed,
- 3) an identification of the specific prior art discussed,
- 4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
- 5) a brief identification of the general thrust of the principal arguments presented to the examiner,  
(The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
- 6) a general indication of any other pertinent matters discussed, and
- 7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

#### Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.

Continuation of Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: The examiner and applicant discussed an overview of the invention and explained features of simultaneous transfer and types of interleaving and allocation of memory based on direction of transmission and bandwidth. The examiner felt the proposed amendment was a step in the right direction but that more details would be recommended to overcome the cited prior art. The examiner suggested the features of need more detailing such as type of memory, type of interleaving to distinguish from the prior art or memory art. .



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

| APPLICATION NO.                                                                         | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.             | CONFIRMATION NO.            |
|-----------------------------------------------------------------------------------------|-------------|----------------------|---------------------------------|-----------------------------|
| 11/246,163                                                                              | 10/11/2005  | Marcos C. Tzannes    | 5550-54                         | 5478                        |
| 62574                                                                                   | 7590        | 12/09/2009           |                                 |                             |
| Jason H. Vick<br>Sheridan Ross, PC<br>Suite # 1200<br>1560 Broadway<br>Denver, CO 80202 |             |                      | EXAMINER<br>PFIZENMAYER, MARK C |                             |
|                                                                                         |             |                      | ART UNIT<br>2447                | PAPER NUMBER                |
|                                                                                         |             |                      | NOTIFICATION DATE<br>12/09/2009 | DELIVERY MODE<br>ELECTRONIC |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

jvick@sheridanross.com



|                              |                        |                     |  |
|------------------------------|------------------------|---------------------|--|
| <b>Office Action Summary</b> | <b>Application No.</b> | <b>Applicant(s)</b> |  |
|                              | 11/246,163             | TZANNES ET AL.      |  |
|                              | <b>Examiner</b>        | <b>Art Unit</b>     |  |
|                              | MARK PFIZENMAYER       | 2447                |  |

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1) ☒ Responsive to communication(s) filed on 21 August 2009.

2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4) ☒ Claim(s) 1-45 is/are pending in the application.

4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.

5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.

6) ☒ Claim(s) 1-45 is/are rejected.

7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.

8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

9) ☒ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
       Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
       Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
       a) ☐ All    b) ☐ Some \* c) ☐ None of:  
           1. ☐ Certified copies of the priority documents have been received.  
           2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
           3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

|                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)<br>2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)<br>3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date <u>9/22/2009</u> . | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date: _____.<br>5) <input type="checkbox"/> Notice of Informal Patent Application<br>6) <input type="checkbox"/> Other: _____. |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**DETAILED ACTION**

1. Claims 19 and 28 were amended in the amendment filed on 8/21/2009. The claims 1-45 are pending.

***Response to Arguments***

2. Applicant's arguments filed 8/21/2009 have been fully considered but they are not persuasive.

**A. Applicant argues the cited prior art does not teach how the same memory can be used for simultaneously receiving of data and transmitting data.**

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., the same memory being used for simultaneously receiving of data and transmitting data) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

***Specification***

3. The disclosure is objected to because of the following informalities:
- The specification fails to provide proper antecedent basis for "an information storage media" in claim 37. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Appropriate correction is required.

***Claim Rejections - 35 USC § 101***

4. 35 U.S.C. 101 reads as follows:

Art Unit: 2447

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

5. Claims 19-36 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

With respect to claim 19, the claim lacks the necessary physical articles or objects to constitute a machine or a manufacture within the meaning of 35 U.S.C. 101. They are clearly not a series of steps or acts to be a process nor are they a combination of chemical compounds to be a composition of matter. As such, they fail to fall within a statutory category. They are, at best, functional descriptive material per se. Claims 20-27 are likewise rejected.

With respect to claim 28, the claim lacks the necessary physical articles or objects to constitute a machine or a manufacture within the meaning of 35 U.S.C. 101. They are clearly not a series of steps or acts to be a process nor are they a combination of chemical compounds to be a composition of matter. As such, they fail to fall within a statutory category. They are, at best, functional descriptive material per se. MPEP §2106.01. Claims 29- 36 are likewise rejected.

***Claim Rejections - 35 USC § 102***

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section

351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claims 1-45 are rejected under 35 U.S.C. 102(e) as being anticipated by Fadavi-Ardekani (U.S. Patent No. 6,707,822).

With respect to claim 1, Fadavi-Ardekani teaches a method for sharing resources in a transceiver (i.e., the IDIM of the transceiver can support different number of sessions; lines 3-5 in column 7) comprising: allocating a first portion of shared memory to a first latency path (i.e., 16 Kbytes is allocated for interleave, lines 25-30 in column 7) and allocating a second portion of the shared memory to a second latency path (i.e., 4 Kbytes is allocated for deinterleave, lines 25-30 in column 7).

With respect to claim 2, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes an interleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new interleave session may be added to an existing interleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 3, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave; lines 3-5 and 30-33 in column 7).

With respect to claim 4, Fadavi-Ardekani further teaches wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver (i.e.,

the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new deinterleave session may be added to an existing deinterleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 5, Fadavi-Ardekani further teaches transmitting to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 6, Fadavi-Ardekani further teaches receiving from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 7, Fadavi-Ardekani further teaches allocating a shared processing module to a plurality of coding and/or decoding modules (i.e., the FCI supports multiple ADSL sessions and performs various tasks on payload data including framing/de-framing, cyclic redundancy check generation/checking,

scrambling/descrambling, Reed-Solomon encoding/decoding, and interleaving/de-interleaving, lines 11-17 in column 6).

With respect to claim 8, Fadavi-Ardekani further teaches wherein the allocating of at least one portion of the shared memory is based on one or more communication parameters (i.e., the number of sessions supported is based on the size of the IDIM and the interleave depth, lines 3-5 and 30-33 in column 7).

With respect to claim 9, Fadavi-Ardekani further teaches wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (i.e., interleave depth, wherein the interleave depth is directly proportional to latency, lines 3-5 in column 7).

With respect to claim 10, Fadavi-Ardekani teaches a transceiver comprising: a first portion of shared memory that is allocated to a first latency path (i.e., 16 Kbytes is allocated for interleave, lines 25-30 in column 7); and a second portion of the shared memory that is allocated to a second latency path (i.e., 4 Kbytes is allocated for deinterleave, lines 25-30 in column 7).

With respect to claim 11, Fadavi-Ardekani further teaches further comprising: an allocation module designed to allocate the shared memory based on one or more communication parameters (i.e., the number of sessions supported is based on the size of the IDIM and the interleave depth, lines 3-5 and 30-33 in column 7).

With respect to claim 12, Fadavi-Ardekani further teaches wherein at least one of the communication parameters is a data rate, a latency, an INP value or a Bit Error Rate

(i.e., interleave depth, wherein the interleave depth is directly proportional to latency, lines 3-5 in column 7).

With respect to claim 13, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes an interleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new interleave session may be added to an existing interleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 14, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave; lines 3-5 and 30-33 in column 7).

With respect to claim 15, Fadavi-Ardekani further teaches wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new deinterleave session may be added to an existing deinterleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 16, Fadavi-Ardekani further teaches further comprising a shared resource management module designed to determine information that is transmitted to another transceiver, wherein the information is used to determine a

maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 17, Fadavi-Ardekani further teaches further comprising a shared resource management module designed to utilize information that is received from another transceiver, wherein the information is used to determine a maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 18, Fadavi-Ardekani further teaches further comprising a shared processing module designed to provide processing resources to a plurality of coding and/or decoding modules (i.e., the FCI supports multiple ADSL sessions and performs various tasks on payload data including framing/de-framing, cyclic redundancy check generation/checking, scrambling/descrambling, Reed-Solomon encoding/decoding, and interleaving/de-interleaving, lines 11-17 in column 6).

With respect to claim 19, Fadavi-Ardekani teaches a system for sharing resources in a transceiver (i.e., the IDIM of the transceiver can support different number of sessions; lines 3-5 in column 7) comprising: means for allocating a first portion of



shared memory to a first latency path (i.e., 16 Kbytes is allocated for interleave, lines 25-30 in column 7) and means for allocating a second portion of the shared memory to a second latency path (i.e., 4 Kbytes is allocated for deinterleave, lines 25-30 in column 7).

With respect to claim 20, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes an interleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new interleave session may be added to an existing interleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 21, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave; lines 3-5 and 30-33 in column 7).

With respect to claim 22, Fadavi-Ardekani further teaches wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new deinterleave session may be added to an existing deinterleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 23, Fadavi-Ardekani further teaches means for transmitting to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 24, Fadavi-Ardekani further teaches means for receiving from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 25, Fadavi-Ardekani further teaches means for allocating a shared processing module to a plurality of coding and/or decoding modules (i.e., the FCI supports multiple ADSL sessions and performs various tasks on payload data including framing/de-framing, cyclic redundancy check generation/checking, scrambling/descrambling, Reed-Solomon encoding/decoding, and interleaving/de-interleaving, lines 11-17 in column 6).

With respect to claim 26, Fadavi-Ardekani further teaches wherein the allocating of at least one portion of the shared memory is based on one or more communication

parameters (i.e., the number of sessions supported is based on the size of the IDIM and the interleave depth, lines 3-5 and 30-33 in column 7).

With respect to claim 27, Fadavi-Ardekani further teaches wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (i.e., interleave depth, wherein the interleave depth is directly proportional to latency, lines 3-5 in column 7).

With respect to claim 28, Fadavi-Ardekani teaches a protocol for sharing resources in a transceiver (i.e., the IDIM of the transceiver can support different number of sessions; lines 3-5 in column 7) comprising: allocating a first portion of shared memory to a first latency path (i.e., 16 Kbytes is allocated for interleave, lines 25-30 in column 7) and allocating a second portion of the shared memory to a second latency path (i.e., 4 Kbytes is allocated for deinterleave, lines 25-30 in column 7).

With respect to claim 29, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes an interleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new interleave session may be added to an existing interleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 30, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver (i.e., the size of the IDIM and the interleave depth may be modified to

allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave; lines 3-5 and 30-33 in column 7).

With respect to claim 31, Fadavi-Ardekani further teaches wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new deinterleave session may be added to an existing deinterleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 32, Fadavi-Ardekani further teaches transmitting to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 33, Fadavi-Ardekani further teaches receiving from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 34, Fadavi-Ardekani further teaches allocating a shared processing module to a plurality of coding and/or decoding modules (i.e., the FCI supports multiple ADSL sessions and performs various tasks on payload data including framing/de-framing, cyclic redundancy check generation/checking, scrambling/descrambling, Reed-Solomon encoding/decoding, and interleaving/de-interleaving, lines 11-17 in column 6).

With respect to claim 35, Fadavi-Ardekani further teaches wherein the allocating of at least one portion of the shared memory is based on one or more communication parameters (i.e., the number of sessions supported is based on the size of the IDIM and the interleave depth, lines 3-5 and 30-33 in column 7).

With respect to claim 36, Fadavi-Ardekani further teaches wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (i.e., interleave depth, wherein the interleave depth is directly proportional to latency, lines 3-5 in column 7).

With respect to claim 37, Fadavi-Ardekani teaches sharing of resources in a transceiver (i.e., the IDIM of the transceiver can support different number of sessions; lines 3-5 in column 7) comprising: information that allocates a first portion of shared memory to a first latency path (i.e., 16 Kbytes is allocated for interleave, lines 25-30 in column 7) and information that allocates a second portion of the shared memory to a second latency path (i.e., 4 Kbytes is allocated for deinterleave, lines 25-30 in column 7).

With respect to claim 38, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes an interleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new interleave session may be added to an existing interleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 39, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave; lines 3-5 and 30-33 in column 7).

With respect to claim 40, Fadavi-Ardekani further teaches wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new deinterleave session may be added to an existing deinterleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 41, Fadavi-Ardekani further teaches further comprising information that transmits to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein

overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 42, Fadavi-Ardekani further teaches further comprising information that receives from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 43, Fadavi-Ardekani further teaches further comprising information that allocates a shared processing module to a plurality of coding and/or decoding modules (i.e., the FCI supports multiple ADSL sessions and performs various tasks on payload data including framing/de-framing, cyclic redundancy check generation/checking, scrambling/descrambling, Reed-Solomon encoding/decoding, and interleaving/de-interleaving, lines 11-17 in column 6).

With respect to claim 44, Fadavi-Ardekani further teaches wherein the allocating of at least one portion of the shared memory is based on one or more communication parameters (i.e., the number of sessions supported is based on the size of the IDIM and the interleave depth, lines 3-5 and 30-33 in column 7).

With respect to claim 45, Fadavi-Ardekani further teaches wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (i.e., interleave depth, wherein the interleave depth is directly proportional to latency,

lines 3-5 in column 7).

***Conclusion***

8. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to MARK PFIZENMAYER whose telephone number is (571)270-7214. The examiner can normally be reached on Monday - Friday 8:00 - 5:30 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, James Hwang can be reached on (571)272-4036. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.



Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Mark Pfizenmayer  
Patent Examiner  
1 December 2009

/Joon H. Hwang/  
Supervisory Patent Examiner, Art Unit 2447

|                                                                                                             |                                            |                                                                  |
|-------------------------------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------------------------------------|
| <b>Index of Claims</b><br> | <b>Application/Control No.</b><br>11246163 | <b>Applicant(s)/Patent Under Reexamination</b><br>TZANNES ET AL. |
|                                                                                                             | <b>Examiner</b><br>Mark Pfizenmayer        | <b>Art Unit</b><br>2447                                          |

|   |                 |   |                   |   |                     |   |                 |
|---|-----------------|---|-------------------|---|---------------------|---|-----------------|
| ✓ | <b>Rejected</b> | - | <b>Cancelled</b>  | N | <b>Non-Elected</b>  | A | <b>Appeal</b>   |
| = | <b>Allowed</b>  | ÷ | <b>Restricted</b> | I | <b>Interference</b> | O | <b>Objected</b> |

| <input type="checkbox"/> Claims renumbered in the same order as presented by applicant |          |            |            | <input type="checkbox"/> CPA |  | <input type="checkbox"/> T.D. |  | <input type="checkbox"/> R.1.47 |  |
|----------------------------------------------------------------------------------------|----------|------------|------------|------------------------------|--|-------------------------------|--|---------------------------------|--|
| CLAIM                                                                                  |          | DATE       |            |                              |  |                               |  |                                 |  |
| Final                                                                                  | Original | 12/29/2008 | 12/01/2009 |                              |  |                               |  |                                 |  |
|                                                                                        | 1        | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 2        | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 3        | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 4        | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 5        | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 6        | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 7        | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 8        | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 9        | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 10       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 11       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 12       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 13       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 14       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 15       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 16       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 17       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 18       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 19       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 20       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 21       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 22       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 23       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 24       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 25       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 26       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 27       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 28       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 29       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 30       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 31       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 32       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 33       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 34       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 35       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 36       | ✓          | ✓          |                              |  |                               |  |                                 |  |

|                                                                                                                                |                                            |                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------------------------------------|
| <p align="center"><b>Index of Claims</b></p>  | <b>Application/Control No.</b><br>11246163 | <b>Applicant(s)/Patent Under Reexamination</b><br>TZANNES ET AL. |
|                                                                                                                                | <b>Examiner</b><br>Mark Pfizenmayer        | <b>Art Unit</b><br>2447                                          |

|   |                 |   |                   |   |                     |   |                 |
|---|-----------------|---|-------------------|---|---------------------|---|-----------------|
| ✓ | <b>Rejected</b> | - | <b>Cancelled</b>  | N | <b>Non-Elected</b>  | A | <b>Appeal</b>   |
| = | <b>Allowed</b>  | ÷ | <b>Restricted</b> | I | <b>Interference</b> | O | <b>Objected</b> |

| <input type="checkbox"/> Claims renumbered in the same order as presented by applicant |          |            |            | <input type="checkbox"/> CPA |  | <input type="checkbox"/> T.D. |  | <input type="checkbox"/> R.1.47 |  |
|----------------------------------------------------------------------------------------|----------|------------|------------|------------------------------|--|-------------------------------|--|---------------------------------|--|
| CLAIM                                                                                  |          | DATE       |            |                              |  |                               |  |                                 |  |
| Final                                                                                  | Original | 12/29/2008 | 12/01/2009 |                              |  |                               |  |                                 |  |
|                                                                                        | 37       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 38       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 39       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 40       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 41       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 42       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 43       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 44       | ✓          | ✓          |                              |  |                               |  |                                 |  |
|                                                                                        | 45       | ✓          | ✓          |                              |  |                               |  |                                 |  |

|                                                                                                              |                                                |                                                                      |
|--------------------------------------------------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------|
| <b>Search Notes</b><br><br> | <b>Application/Control No.</b><br><br>11246163 | <b>Applicant(s)/Patent Under Reexamination</b><br><br>TZANNES ET AL. |
|                                                                                                              | <b>Examiner</b><br><br>Mark Pfizenmayer        | <b>Art Unit</b><br><br>2447                                          |

| SEARCHED |          |      |          |
|----------|----------|------|----------|
| Class    | Subclass | Date | Examiner |
|          |          |      |          |

| SEARCH NOTES                        |  |          |          |
|-------------------------------------|--|----------|----------|
| Search Notes                        |  | Date     | Examiner |
| See search history printout         |  | Nov 2009 | MCP      |
| 709/215 with text                   |  | Nov 2009 | MCP      |
| Discussed with Primary Ben Bruckart |  | Nov 2009 | MCP      |

| INTERFERENCE SEARCH |          |      |          |
|---------------------|----------|------|----------|
| Class               | Subclass | Date | Examiner |
|                     |          |      |          |

|  |  |
|--|--|
|  |  |
|--|--|

## EAST Search History

## EAST Search History (Prior Art)

| Ref # | Hits | Search Query                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | DBs                                                   | Default Operator | Plurals | Time Stamp          |
|-------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|------------------|---------|---------------------|
| L1    | 50   | ("20060088054"<br>"5781549" "5572686"<br>"6065101" "6374332"<br>"6411418" "6988173"<br>"7069362" "7085898"<br>"7111130"<br>"20040054857"<br>"20040076044"<br>"20040230726"<br>"20040230751"<br>"20040230752"<br>"20060184750"<br>"20060246907"<br>"5477539"<br>"20080232444"<br>"6195334" "5644576"<br>"5898904" "6674971"<br>"6690934"<br>"20070043945"<br>"20070076655"<br>"20090239548"<br>"5524234" "6138208"<br>"6185640" "5307459"<br>"5337285" "5412782"<br>"5485584" "5498990"<br>"5526510" "5537573"<br>"5613077" "5649302"<br>"5713005" "5729705"<br>"5734848" "5737587"<br>"5805836" "5815667"<br>"5831467" "5844576"<br>"5872920" "5943504"<br>"5974511" ).pn. | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR               | ON      | 2009/12/01<br>17:46 |
| L2    | 0    | L1 and 709/215.ccls.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR               | ON      | 2009/12/01<br>17:46 |
| S1    | 5    | ("6337877"  <br>"6707822"  <br>"6775320"  <br>"6778589"  <br>"6778596").PN.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR               | ON      | 2009/11/22<br>16:01 |

## EAST Search History

|    |    |                                                                                                                                                                                                                                                                                                                                                                                            |                                                       |    |    |                     |
|----|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----|----|---------------------|
| S2 | 1  | "20060088054".pn.                                                                                                                                                                                                                                                                                                                                                                          | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2009/11/22<br>16:06 |
| S3 | 1  | "7042891".pn. and<br>latency adj path                                                                                                                                                                                                                                                                                                                                                      | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2009/11/22<br>17:17 |
| S4 | 5  | ("6337877"  <br>"6707822"  <br>"6775320"  <br>"6778589"  <br>"6778596").PN.                                                                                                                                                                                                                                                                                                                | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2009/11/22<br>17:19 |
| S5 | 3  | S4 and latency adj<br>path                                                                                                                                                                                                                                                                                                                                                                 | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2009/11/22<br>17:19 |
| S6 | 4  | S4 and latency                                                                                                                                                                                                                                                                                                                                                                             | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2009/11/22<br>17:20 |
| S7 | 4  | S4 and path                                                                                                                                                                                                                                                                                                                                                                                | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2009/11/22<br>17:22 |
| S8 | 50 | ("20060088054"<br>"5781549" "5572686"<br>"6065101" "6374332"<br>"6411418" "6988173"<br>"7069362" "7085898"<br>"7111130"<br>"20040054857"<br>"20040076044"<br>"20040230726"<br>"20040230751"<br>"20040230752"<br>"20060184750"<br>"20060246907"<br>"5477539"<br>"20080232444"<br>"6195334" "5644576"<br>"5898904" "6674971"<br>"6690934"<br>"20070043945"<br>"20070076655"<br>"20090239548" | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2009/11/29<br>16:51 |

file:///C:/Documents%20and%20Settings/mpfizenmayer/My...6163/EASTSearchHistory.11246163\_AccessibleVersion.htm (2 of 3)12/1/2009 5:47:25 PM

## EAST Search History

|     |   |                                                                                                                                                                                                                                                                              |                                                       |    |    |                     |
|-----|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----|----|---------------------|
|     |   | "5524234" "6138208"<br>"6185640" "5307459"<br>"5337285" "5412782"<br>"5485584" "5498990"<br>"5526510" "5537573"<br>"5613077" "5649302"<br>"5713005" "5729705"<br>"5734848" "5737587"<br>"5805836" "5815667"<br>"5831467" "5844576"<br>"5872920" "5943504"<br>"5974511" ).pn. |                                                       |    |    |                     |
| S9  | 1 | "20060088054".pn.<br>and memory                                                                                                                                                                                                                                              | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2009/11/29<br>16:53 |
| S10 | 1 | "20060088054".pn.<br>and hard                                                                                                                                                                                                                                                | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2009/11/29<br>16:57 |
| S11 | 1 | "6775320".pn.                                                                                                                                                                                                                                                                | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2009/11/29<br>17:00 |
| S12 | 1 | "6775320".pn. and fci                                                                                                                                                                                                                                                        | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>IBM_TDB | OR | ON | 2009/11/29<br>17:01 |

## EAST Search History (I nterference)

&lt; This search history is empty &gt;

12/ 1/ 2009 5:47:17 PM

C:\ Documents and Settings\ mpfizenmayer\ My Documents\ EAST\ Workspaces  
\ 163\_Resource\_Share\_telecom.wsp

Receipt date: 09/22/2009

11246163 - GAU: 2447

|                                                                                                      |   |    |   |                          |                  |
|------------------------------------------------------------------------------------------------------|---|----|---|--------------------------|------------------|
| <b>Substitute for form 1449A/PTO</b><br><br><b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b> |   |    |   | <b>Complete if Known</b> |                  |
|                                                                                                      |   |    |   | Application Number       | 11/246,163       |
|                                                                                                      |   |    |   | Filing Date              | October 11, 2005 |
|                                                                                                      |   |    |   | First Named Inventor     | LUND, MICHAEL    |
|                                                                                                      |   |    |   | Art Unit                 | 2447             |
|                                                                                                      |   |    |   | Examiner Name            | HWANG, JOON H    |
| Sheet                                                                                                | 1 | of | 1 | Attorney Docket Number   | 5550-54          |

| U.S. PATENT DOCUMENTS |                          |                                                             |                                |                                                    |                                                                                 |
|-----------------------|--------------------------|-------------------------------------------------------------|--------------------------------|----------------------------------------------------|---------------------------------------------------------------------------------|
| Examiner<br>Initials* | Cite<br>No. <sup>1</sup> | Document Number<br>Number-kind Code <sup>2 (if known)</sup> | Publication Date<br>MM-DD-YYYY | Name of Patentee of<br>Applicant of Cited Document | Pages, Columns, Lines, Where<br>Relevant Passages or Relevant<br>Figures Appear |

| FOREIGN PATENT DOCUMENTS |                          |                                                                                                                       |                                   |                                                    |                                                                                          |                |
|--------------------------|--------------------------|-----------------------------------------------------------------------------------------------------------------------|-----------------------------------|----------------------------------------------------|------------------------------------------------------------------------------------------|----------------|
| Examiner<br>Initials*    | Cite<br>No. <sup>1</sup> | Foreign Patent Document<br><br>Country Code <sup>3</sup> ; Number <sup>4</sup> ; Kind<br>Code <sup>5</sup> (if known) | Publication<br>Date<br>MM-DD-YYYY | Name of Patentee or<br>Applicant of Cited Document | Pages, Columns,<br>Lines, Where<br>Relevant<br>Passages or<br>Relevant Figures<br>Appear | T <sup>6</sup> |

| OTHER ART (Including Author, Title, Date, Pertinent Pages, etc.) |                          |                                                                                                                                 |
|------------------------------------------------------------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| Examiner<br>Initials*                                            | Cite<br>No. <sup>1</sup> |                                                                                                                                 |
|                                                                  | 1                        | Examiner's First Report for Australian Patent Application No. 2005296086, mailed June 24, 2009<br>(Attorney's Ref. No. 5550-54) |

|                       |                    |                    |            |
|-----------------------|--------------------|--------------------|------------|
| Examiner<br>Signature | /Mark Pfizenmayer/ | Date<br>Considered | 11/29/2009 |
|-----------------------|--------------------|--------------------|------------|

\*EXAMINER: Initial if reference is considered, whether or not citation is in conformance and not considered. Include copy of this form with next communication to applicant.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /M.P./



PLUS Search Results for S/N 11246163, Searched Mon Nov 23 09:02:44 EST 2009  
The Patent Linguistics Utility System (PLUS) is a USPTO automated search system for U.S. Patents from 1971 to the present PLUS is a query-by-example search system which produces a list of patents that are most closely related linguistically to the application searched. This search was prepared by the staff of the Scientific and Technical Information Center, SIRA.

|                |            |
|----------------|------------|
| 20060088054 99 | 5974511 52 |
| 5781549 66     |            |
| 5572686 66     |            |
| 6065101 66     |            |
| 6374332 66     |            |
| 6411418 66     |            |
| 6988173 66     |            |
| 7069362 66     |            |
| 7085898 66     |            |
| 7111130 66     |            |
| 20040054857 66 |            |
| 20040076044 66 |            |
| 20040230726 66 |            |
| 20040230751 66 |            |
| 20040230752 66 |            |
| 20060184750 66 |            |
| 20060246907 63 |            |
| 5477539 55     |            |
| 20080232444 53 |            |
| 6195334 52     |            |
| 5644576 52     |            |
| 5898904 52     |            |
| 6674971 52     |            |
| 6690934 52     |            |
| 20070043945 52 |            |
| 20070076655 52 |            |
| 20090239548 52 |            |
| 5524234 52     |            |
| 6138208 52     |            |
| 6185640 52     |            |
| 5307459 52     |            |
| 5337285 52     |            |
| 5412782 52     |            |
| 5485584 52     |            |
| 5498990 52     |            |
| 5526510 52     |            |
| 5537573 52     |            |
| 5613077 52     |            |
| 5649302 52     |            |
| 5713005 52     |            |
| 5729705 52     |            |
| 5734848 52     |            |
| 5737587 52     |            |
| 5805836 52     |            |
| 5815667 52     |            |
| 5831467 52     |            |
| 5844576 52     |            |
| 5872920 52     |            |
| 5943504 52     |            |

|                                                          |   |    |   |                          |                  |
|----------------------------------------------------------|---|----|---|--------------------------|------------------|
| Substitute for form 1449A/PTO                            |   |    |   | <b>Complete if Known</b> |                  |
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b> |   |    |   | Application Number       | 11/246,163       |
|                                                          |   |    |   | Filing Date              | October 11, 2005 |
|                                                          |   |    |   | First Named Inventor     | LUND, MICHAEL    |
|                                                          |   |    |   | Art Unit                 | 2447             |
|                                                          |   |    |   | Examiner Name            | HWANG, JOON H    |
| Sheet                                                    | 1 | of | 1 | Attorney Docket Number   | 5550-54          |

| U.S. PATENT DOCUMENTS |                          |                                                             |                                |                                                    |                                                                                 |
|-----------------------|--------------------------|-------------------------------------------------------------|--------------------------------|----------------------------------------------------|---------------------------------------------------------------------------------|
| Examiner<br>Initials* | Cite<br>No. <sup>1</sup> | Document Number<br>Number-kind Code <sup>2 (if known)</sup> | Publication Date<br>MM-DD-YYYY | Name of Patentee of<br>Applicant of Cited Document | Pages, Columns, Lines, Where<br>Relevant Passages or Relevant<br>Figures Appear |

| FOREIGN PATENT DOCUMENTS |                          |                                                                                                                   |                                   |                                                    |                                                                                          |                |
|--------------------------|--------------------------|-------------------------------------------------------------------------------------------------------------------|-----------------------------------|----------------------------------------------------|------------------------------------------------------------------------------------------|----------------|
| Examiner<br>Initials*    | Cite<br>No. <sup>1</sup> | Foreign Patent Document<br>Country Code <sup>3</sup> ; Number <sup>4</sup> ; Kind<br>Code <sup>5</sup> (if known) | Publication<br>Date<br>MM-DD-YYYY | Name of Patentee or<br>Applicant of Cited Document | Pages, Columns,<br>Lines, Where<br>Relevant<br>Passages or<br>Relevant Figures<br>Appear | T <sup>6</sup> |

| OTHER ART (Including Author, Title, Date, Pertinent Pages, etc.) |                          |                                                                                                                                 |
|------------------------------------------------------------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| Examiner<br>Initials*                                            | Cite<br>No. <sup>1</sup> |                                                                                                                                 |
|                                                                  | 1                        | Examiner's First Report for Australian Patent Application No. 2005296086, mailed June 24, 2009<br>(Attorney's Ref. No. 5550-54) |

|                       |  |                    |  |
|-----------------------|--|--------------------|--|
| Examiner<br>Signature |  | Date<br>Considered |  |
|-----------------------|--|--------------------|--|

\*EXAMINER: Initial if reference is considered, whether or not citation is in conformance and not considered. Include copy of this form with next communication to applicant.

| Electronic Acknowledgement Receipt   |                                                      |
|--------------------------------------|------------------------------------------------------|
| EFS ID:                              | 6119916                                              |
| Application Number:                  | 11246163                                             |
| International Application Number:    |                                                      |
| Confirmation Number:                 | 5478                                                 |
| Title of Invention:                  | Resource sharing in a telecommunications environment |
| First Named Inventor/Applicant Name: | Marcos C. Tzannes                                    |
| Customer Number:                     | 62574                                                |
| Filer:                               | Jason Vick/Debra Kesner                              |
| Filer Authorized By:                 | Jason Vick                                           |
| Attorney Docket Number:              | 5550-54                                              |
| Receipt Date:                        | 22-SEP-2009                                          |
| Filing Date:                         | 11-OCT-2005                                          |
| Time Stamp:                          | 14:47:11                                             |
| Application Type:                    | Utility under 35 USC 111(a)                          |

**Payment information:**

|                        |    |
|------------------------|----|
| Submitted with Payment | no |
|------------------------|----|

**File Listing:**

| Document Number | Document Description | File Name  | File Size(Bytes)/<br>Message Digest                | Multi Part /.zip | Pages (if appl.) |
|-----------------|----------------------|------------|----------------------------------------------------|------------------|------------------|
| 1               |                      | IDS_03.pdf | 330792<br>c92050b4e1f32a348ee1a8ba787034fb4121de7c | yes              | 4                |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                            |                                         |              |            |    |  |  |  |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|-----------------------------------------|--------------|------------|----|--|--|--|--|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Multipart Description/PDF files in .zip description</b> |                                         |              |            |    |  |  |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Document Description</b>                                |                                         | <b>Start</b> | <b>End</b> |    |  |  |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Transmittal Letter                                         |                                         | 1            | 3          |    |  |  |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Information Disclosure Statement (IDS) Filed (SB/08)       |                                         | 4            | 4          |    |  |  |  |  |
| <b>Warnings:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                            |                                         |              |            |    |  |  |  |  |
| <b>Information:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                            |                                         |              |            |    |  |  |  |  |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | NPL Documents                                              | 5550-54-PAU_OA_6-24-09.pdf              | 1621631      | no         | 30 |  |  |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                            | 6e6bcea1107bdeecadfd28cca73d27a840590ac |              |            |    |  |  |  |  |
| <b>Warnings:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                            |                                         |              |            |    |  |  |  |  |
| <b>Information:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                            |                                         |              |            |    |  |  |  |  |
| <b>Total Files Size (in bytes):</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                            |                                         | 1952423      |            |    |  |  |  |  |
| <p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><b>New Applications Under 35 U.S.C. 111</b><br/> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><b>National Stage of an International Application under 35 U.S.C. 371</b><br/> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><b>New International Application Filed with the USPTO as a Receiving Office</b><br/> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p> |                                                            |                                         |              |            |    |  |  |  |  |

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

|                                  |   |                               |
|----------------------------------|---|-------------------------------|
| In Re the Application of:        | ) | Group Art Unit: 2447          |
| LUND, MICHAEL                    | ) | Confirmation No.: 5478        |
| Serial No.: 11/246,163           | ) | Examiner: HWANG, JOON H       |
| Filed: October 11, 2005          | ) |                               |
| Atty. File No.: 5550-54          | ) | <u>INFORMATION DISCLOSURE</u> |
| Entitled: "RESOURCE SHARING IN A | ) | <u>STATEMENT</u>              |
| TELECOMMUNICATIONS ENVIRONMENT"  | ) | Electronically Submitted      |

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

The references cited on attached Form PTO-1449 are being called to the attention of the Examiner.

- ☒ Copies of the cited non-patent and/or foreign references are enclosed herewith.
- ☐ Copies of the cited U.S. patents and/or patent applications are enclosed herewith.
- ☐ Copies of the cited U.S. patents/patent application publications are not enclosed in accordance with 37 C.F.R. § 1.98(a).
- ☐ Copies of the cited references are not enclosed, in accordance with 37 C.F.R. § 1.98(d), because the references were cited by or submitted to the U.S. Patent and Trademark Office in prior application Serial No. \_\_\_\_\_ filed \_\_\_\_\_, which is relied upon for an earlier filing date under 35 U.S.C. § 120.
- ☐ To the best of applicants' belief, the pertinence of the foreign-language references are believed to be summarized in the attached English abstracts and in the figures, although applicants do not necessarily vouch for the accuracy of the translation.
- ☐ Examiner's attention is drawn to the following related applications:
- Serial No. \_\_\_\_\_ filed \_\_\_\_\_ (Attorney's Ref. No. \_\_\_\_\_)
- Serial No. \_\_\_\_\_ filed \_\_\_\_\_ (Attorney's Ref. No. \_\_\_\_\_)
- ☐ Other: \_\_\_\_\_

Submission of the above information is not intended as an admission that any item is citable under the statutes or rules to support a rejection, that any item disclosed represents analogous art, or that those skilled in the art would refer to or recognize the

pertinence of any reference without the benefit of hindsight, nor should an inference be drawn as to the pertinence of the references based on the order in which they are presented. Submission of this statement should not be taken as an indication that a search has been conducted, or that no better art exists.

It is respectfully requested that the cited information be expressly considered during the prosecution of this application and the references made of record therein.

### FEES

|                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/>            | <p><b>37 CFR 1.97(b):</b> No fee is believed due in connection with this submission, because the information disclosure statement submitted herewith is satisfied by one of the following conditions ("X" indicates satisfaction):</p> <p><input type="checkbox"/> Within three months of the filing date of a national application other than a continued prosecution application under 37 CFR 1.53(d), or</p> <p><input type="checkbox"/> Within three months of the date of entry into the national stage of an international application as set forth in 37 CFR 1.491 or</p> <p><input type="checkbox"/> Before the mailing date of a first Office Action on the merits, or</p> <p><input type="checkbox"/> Before the mailing of a first Office action after the filing of a request for continued examination under 37 CFR 1.114.</p> <p>Although no fee is believed due, if any fee is deemed due in connection with this submission, please charge such fee to Deposit Account 19-1970.</p>                                      |
| <input checked="" type="checkbox"/> | <p><b>37 CFR 1.97(c):</b> The information disclosure statement transmitted herewith is being filed after all the above conditions (37 CFR 1.97(b)), but before the mailing date of one of the following conditions:</p> <p>(1) a final action under 37 C.F.R. 1.113 or</p> <p>(2) a notice of allowance under 37 C.F.R. 1.311, or</p> <p>(3) an action that otherwise closes prosecution in the application.</p> <p>This Information Disclosure Statement is accompanied by:</p> <p><input checked="" type="checkbox"/> A Certification (below) as specified by 37 C.F.R. 1.97(e). Although no fee is believed due, if any fee is deemed due in connection with this submission, please charge such fee to Deposit Account 19-1970.</p> <p>OR</p> <p><input type="checkbox"/> Please charge Deposit Account 19-1970 in the amount of \$180.00 for the fee set forth in 37 C.F.R. 1.17(p) for submission of an information disclosure statement. Please credit any overpayment or charge any underpayment to Deposit Account 19-1970.</p> |
| <input type="checkbox"/>            | <p><b>37 CFR 1.97(d):</b> This Information Disclosure Statement is being submitted after the period specified in 37 CFR 1.97(c).</p> <p><input type="checkbox"/> This information Disclosure Statement includes a Certification (below) as specified by 37 C.F.R. 1.97(e)</p> <p>AND</p> <p><input type="checkbox"/> Applicants hereby requests consideration of the reference(s) disclosed herein. Please charge Deposit Account 19-1970 in the amount of \$180.00 under 37 C.F.R. 1.17(p). Please credit any overpayment or charge any underpayment to Deposit Account 19-1970. Election to pay the fee should not be taken as an indication that applicant(s) cannot execute a certification.</p>                                                                                                                                                                                                                                                                                                                                     |

**Certification (37 C.F.R. 1.97(e))**  
(Applicable only if checked)



The undersigned certifies that:



Each item of information contained in this information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this statement. 37 C.F.R. 1.97(e)(1).



A copy of the communication from the foreign patent office is enclosed.

OR



No item of information contained in this information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the undersigned after making reasonable inquiry, no item of information contained in this Information Disclosure Statement was known to any individual designated in 37 C.F.R. 1.56(c) more than three months prior to the filing of this statement. 37 C.F.R. 1.97(e)(2).

Respectfully submitted,

SHERIDAN ROSS P.C.

By: \_\_\_\_\_

Jason H. Vick

Registration No. 45,285

1560 Broadway, Suite 1200

Denver, Colorado 80202-5141

(303) 863-9700

Date: 22 Sept 169

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

|                                          |   |                          |
|------------------------------------------|---|--------------------------|
| In Re the Application of: Tzannes et al. | ) | Group Art Unit: 2447     |
| Application No.: 11/246,163              | ) | Examiner: LEUNG, Jack C. |
| Filed: October 11, 2005                  | ) | Confirmation No.: 5478   |
| Atty. File No.: 5550-54                  | ) |                          |

For: RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT

**AMENDMENT AND RESPONSE**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

Applicants submit this Amendment and Response to address the Office Action having a mailing date of February 24, 2009. Please credit any overpayment or charge any underpayment to Deposit Account No. 19-1970.

Please amend the above-identified patent application as follows:

**Amendments to the Specification** begin on page 2 of this paper.

**Amendments to the Claims** are shown in the listing of claims which begins on page 3 of this paper.

**Remarks** begin on page 8 of this paper.



**Amendments to the Specification:**

Please amend the Specification as follows:

[0006] Accordingly, an exemplary aspect of this invention relates to sharing memory between one or more interleavers and/or ~~deinterlaevers~~ deinterleavers in a transceiver. More particularly, an exemplary aspect of this invention relates to shared latency path memory in a transceiver.

[00048] Example #1

A first transmitter portion or receiver portion latency path may carry data from a video application, which needs a very low BER but can tolerate higher latency. In this case, the video will be transported using an latency path that has a large amount of interleaving/deinterleaving and coding (also known as Forward Error Correction (FEC) coding). For example, the latency path may be configured with Reed-Solomon coding using a codeword size of 255 bytes ( $N=255$ ) with 16 checkbytes ( $R=16$ ) and interleaving/deinterleaving using an interleaver depth of 64 ( $D=64$ ). This latency path will require  ~~$N*D=16*255=16\text{Kbytes}$~~   $N*D=255*64=16\text{Kbytes}$  of interleaver memory at the transmitter (or de-interleaver memory at the receiver). This latency path will be able to correct a burst of errors that is less than 512 bytes in duration.

**Amendments to the Claims:**

This listing of claims will replace all prior versions, and listings, of claims in the application:

**Listing of Claims:**

1. (Original) A method for sharing resources in a transceiver comprising:  
allocating a first portion of shared memory to a first latency path and allocating a second portion of the shared memory to a second latency path.
2. (Original) The method of claim 1, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.
3. (Original) The method of claim 1, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.
4. (Original) The method of claim 1, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.
5. (Original) The method of claim 1, further comprising transmitting to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.
6. (Original) The method of claim 1, further comprising receiving from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.
7. (Original) The method of claim 1, further comprising allocating a shared processing module to a plurality of coding and/or decoding modules.
8. (Original) The method of claim 1, wherein the allocating of at least one portion of the shared memory is based on one or more communication parameters.
9. (Original) The method of claim 8, wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (BER).
10. (Original) A transceiver comprising:  
a first portion of shared memory that is allocated to a first latency path; and

a second portion of the shared memory that is allocated to a second latency path.

11. (Original) The transceiver of claim 10, further comprising:  
an allocation module designed to allocate the shared memory based on one or more communication parameters.
12. (Original) The transceiver of claim 11, wherein at least one of the communication parameters is a data rate, a latency, an INP value or a Bit Error Rate (BER).
13. (Original) The transceiver of claim 10, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.
14. (Original) The transceiver of claim 10, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.
15. (Original) The transceiver of claim 10, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.
16. (Original) The transceiver of claim 10, further comprising a shared resource management module designed to determine information that is transmitted to another transceiver, wherein the information is used to determine a maximum amount of shared memory that can be allocated.
17. (Original) The transceiver of claim 10, further comprising a shared resource management module designed to utilize information that is received from another transceiver, wherein the information is used to determine a maximum amount of shared memory that can be allocated.
18. (Original) The transceiver of claim 10, further comprising a shared processing module designed to provide processing resources to a plurality of coding and/or decoding modules.
19. (Currently Amended) A system for sharing resources, such as memory, in a transceiver comprising:  
means for allocating a first portion of a shared memory to a first latency path and means for allocating a second portion of the shared memory to a second latency path.

20. (Original) The system of claim 19, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.

21. (Original) The system of claim 19, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.

22. (Original) The system of claim 19, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.

23. (Original) The system of claim 19, further comprising means for transmitting to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

24. (Original) The system of claim 19, further comprising means for receiving from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

25. (Original) The system of claim 19, further comprising means for allocating a shared processing module to a plurality of coding and/or decoding modules.

26. (Original) The system of claim 19, wherein the allocating of at least one portion of the shared memory is based on one or more communication parameters.

27. (Original) The system of claim 26, wherein at least one of the communication parameters is a data rate, a latency, an INP-value or a bit error rate (BER).

28. (Currently Amended) A protocol for sharing resources, such as memory, in a transceiver comprising:

allocating a first portion of a shared memory to a first latency path and allocating a second portion of the shared memory to a second latency path.

29. (Original) The protocol of claim 28, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.

30. (Original) The protocol of claim 28, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.

31. (Original) The protocol of claim 28, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.

32. (Original) The protocol of claim 28, further comprising transmitting to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

33. (Original) The protocol of claim 28, further comprising receiving from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

34. (Original) The protocol of claim 28, further comprising allocating a shared processing module to a plurality of coding and/or decoding modules.

35. (Original) The protocol of claim 28, wherein the allocating of at least one portion of the shared memory is based on one or more communication parameters.

36. (Original) The protocol of claim 35, wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (BER).

37. (Original) An information storage media having stored thereon information that when executed allows sharing of resources in a transceiver comprising:

information that allocates a first portion of shared memory to a first latency path and information that allocates a second portion of the shared memory to a second latency path.

38. (Original) The media of claim 37, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.

39. (Original) The media of claim 37, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.

40. (Original) The media of claim 37, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.

41. (Original) The media of claim 37, further comprising information that transmits to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

42. (Original) The media of claim 37, further comprising information that receives from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

43. (Original) The media of claim 37, further comprising information that allocates a shared processing module to a plurality of coding and/or decoding modules.

44. (Original) The media of claim 37, wherein the allocating of at least one portion of the shared memory is based on one or more communication parameters.

45. (Original) The media of claim 44, wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (BER).

### REMARKS

Applicant respectfully requests reconsideration of this application as amended.

By this amendment, the outstanding objections have been addressed in accordance with the Examiner's recommendations.

Additionally, the 35 U.S.C. §101 rejections have been addressed and it is believed the rejected claims are in compliance therewith.

Regarding the art-based rejections, Fadavi-Ardekani states that "a simple of a transmit interleaver for standard ADSL requires 16 Kbytes per session for downstream processing and 2 Kbytes per session for upstream processing." Fadavi-Ardekani then states that "the invention utilizes the same memory for receive data and transmit data and thus requires 20 Kbytes to support a standard ADSL session at full interleave depth..."

MPEP 2121.01 states that "In determining that quantum of prior art disclosure which is necessary to declare an applicant's invention 'not novel' or 'anticipated' within section 102, the stated test is whether a reference contains an 'enabling disclosure'... ." In re Hoeksema, 399 F.2d 269, 158 USPQ 596 (CCPA 1968). The disclosure in an assertedly anticipating reference must provide an enabling disclosure of the desired subject matter; mere naming or description of the subject matter is insufficient, if it cannot be produced without undue experimentation. Elan Pharm., Inc. v. \*\*>Mayo Found. For Med. Educ. & Research<, 346 F.3d 1051, 1054, 68 USPQ2d 1373, 1376 (Fed. Cir. 2003).

Applicants respectfully submit Fadavi-Ardekani is not enabling for how the same memory can be used for simultaneous receiving of data and transmitting of data.

In that Fadavi-Ardekani is not enabling, Applicants respectfully submit Fadavi-Ardekani is not anticipatory of the claimed subject matter.

Applicants therefore respectfully submit the application is patentably distinguishable from the cited reference and respectfully request a Notice of Allowance.

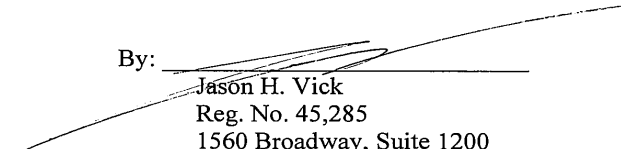
As discussed with SPE James Joon Hwang, the Examiner assigned to examining this application is respectfully requested to contact the undersigned to schedule a Personal Interview to discuss the merits of the application. As also discussed, the next Office Action, if not a Notice of Allowance, will not be made final.

The Commissioner is hereby authorized to charge to deposit account number 19-1970 any fees under 37 CFR § 1.16 and 1.17 that may be required by this paper and to credit any overpayment to that Account. If any extension of time is required in connection with the filing of this paper and has not been separately requested, such extension is hereby petitioned.

Respectfully submitted,

SHERIDAN ROSS P.C.

Date: 21 Aug 09

By:   
Jason H. Vick  
Reg. No. 45,285  
1560 Broadway, Suite 1200  
Denver, Colorado 80202  
Telephone: 303-863-9700



Under the paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

| <b>PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)</b><br><b>FY 2009</b><br><i>(Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818).)</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        | Docket Number (Optional)<br>5550-54 |          |     |                  |  |                                                        |       |      |          |                                                         |       |       |          |                                                                      |        |       |         |                                                          |        |       |          |                                                          |        |        |          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------------------------------------|----------|-----|------------------|--|--------------------------------------------------------|-------|------|----------|---------------------------------------------------------|-------|-------|----------|----------------------------------------------------------------------|--------|-------|---------|----------------------------------------------------------|--------|-------|----------|----------------------------------------------------------|--------|--------|----------|
| Application Number 11/246,163                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |        | Filed October 11, 2005              |          |     |                  |  |                                                        |       |      |          |                                                         |       |       |          |                                                                      |        |       |         |                                                          |        |       |          |                                                          |        |        |          |
| For <b>RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |                                     |          |     |                  |  |                                                        |       |      |          |                                                         |       |       |          |                                                                      |        |       |         |                                                          |        |       |          |                                                          |        |        |          |
| Art Unit 2447                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |        | Examiner LEUNG, Jack C.             |          |     |                  |  |                                                        |       |      |          |                                                         |       |       |          |                                                                      |        |       |         |                                                          |        |       |          |                                                          |        |        |          |
| <p>This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above identified application.</p> <p>The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):</p> <table><thead><tr><th></th><th>Fee</th><th>Small Entity Fee</th><th></th></tr></thead><tbody><tr><td><input type="checkbox"/> One month (37 CFR 1.17(a)(1))</td><td>\$130</td><td>\$65</td><td>\$ _____</td></tr><tr><td><input type="checkbox"/> Two months (37 CFR 1.17(a)(2))</td><td>\$490</td><td>\$245</td><td>\$ _____</td></tr><tr><td><input checked="" type="checkbox"/> Three months (37 CFR 1.17(a)(3))</td><td>\$1110</td><td>\$555</td><td>\$ 1110</td></tr><tr><td><input type="checkbox"/> Four months (37 CFR 1.17(a)(4))</td><td>\$1730</td><td>\$865</td><td>\$ _____</td></tr><tr><td><input type="checkbox"/> Five months (37 CFR 1.17(a)(5))</td><td>\$2350</td><td>\$1175</td><td>\$ _____</td></tr></tbody></table> <p><input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27.</p> <p><input type="checkbox"/> A check in the amount of the fee is enclosed.</p> <p><input type="checkbox"/> Payment by credit card. Form PTO-2038 is attached.</p> <p><input checked="" type="checkbox"/> The Director has already been authorized to charge fees in this application to a Deposit Account.</p> <p><input checked="" type="checkbox"/> The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number <u>19-1970</u>.</p> <p><b>WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.</b></p> <p>I am the <input type="checkbox"/> applicant/inventor.</p> <p><input type="checkbox"/> assignee of record of the entire interest. See 37 CFR 3.71.<br/>Statement under 37 CFR 3.73(b) is enclosed (Form PTO/SB/96).</p> <p><input checked="" type="checkbox"/> attorney or agent of record. Registration Number <u>45,285</u></p> <p><input type="checkbox"/> attorney or agent under 37 CFR 1.34.<br/>Registration number if acting under 37 CFR 1.34 _____</p> <p>_____<br/>Signature</p> <p>21 Aug '09<br/>Date</p> <p>Jason H. Vick<br/>Typed or printed name</p> <p>303-863-9700<br/>Telephone Number</p> <p>NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below.</p> <p><input checked="" type="checkbox"/> Total of <u>1</u> forms are submitted.</p> |        |                                     |          | Fee | Small Entity Fee |  | <input type="checkbox"/> One month (37 CFR 1.17(a)(1)) | \$130 | \$65 | \$ _____ | <input type="checkbox"/> Two months (37 CFR 1.17(a)(2)) | \$490 | \$245 | \$ _____ | <input checked="" type="checkbox"/> Three months (37 CFR 1.17(a)(3)) | \$1110 | \$555 | \$ 1110 | <input type="checkbox"/> Four months (37 CFR 1.17(a)(4)) | \$1730 | \$865 | \$ _____ | <input type="checkbox"/> Five months (37 CFR 1.17(a)(5)) | \$2350 | \$1175 | \$ _____ |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Fee    | Small Entity Fee                    |          |     |                  |  |                                                        |       |      |          |                                                         |       |       |          |                                                                      |        |       |         |                                                          |        |       |          |                                                          |        |        |          |
| <input type="checkbox"/> One month (37 CFR 1.17(a)(1))                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | \$130  | \$65                                | \$ _____ |     |                  |  |                                                        |       |      |          |                                                         |       |       |          |                                                                      |        |       |         |                                                          |        |       |          |                                                          |        |        |          |
| <input type="checkbox"/> Two months (37 CFR 1.17(a)(2))                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | \$490  | \$245                               | \$ _____ |     |                  |  |                                                        |       |      |          |                                                         |       |       |          |                                                                      |        |       |         |                                                          |        |       |          |                                                          |        |        |          |
| <input checked="" type="checkbox"/> Three months (37 CFR 1.17(a)(3))                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | \$1110 | \$555                               | \$ 1110  |     |                  |  |                                                        |       |      |          |                                                         |       |       |          |                                                                      |        |       |         |                                                          |        |       |          |                                                          |        |        |          |
| <input type="checkbox"/> Four months (37 CFR 1.17(a)(4))                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | \$1730 | \$865                               | \$ _____ |     |                  |  |                                                        |       |      |          |                                                         |       |       |          |                                                                      |        |       |         |                                                          |        |       |          |                                                          |        |        |          |
| <input type="checkbox"/> Five months (37 CFR 1.17(a)(5))                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | \$2350 | \$1175                              | \$ _____ |     |                  |  |                                                        |       |      |          |                                                         |       |       |          |                                                                      |        |       |         |                                                          |        |       |          |                                                          |        |        |          |

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

| Electronic Patent Application Fee Transmittal  |                 |                                                      |               |                             |
|------------------------------------------------|-----------------|------------------------------------------------------|---------------|-----------------------------|
| <b>Application Number:</b>                     |                 | 11246163                                             |               |                             |
| <b>Filing Date:</b>                            |                 | 11-Oct-2005                                          |               |                             |
| <b>Title of Invention:</b>                     |                 | Resource sharing in a telecommunications environment |               |                             |
| <b>First Named Inventor/Applicant Name:</b>    |                 | Marcos C. Tzannes                                    |               |                             |
| <b>Filer:</b>                                  |                 | Jason Vick/Joanne Vos                                |               |                             |
| <b>Attorney Docket Number:</b>                 |                 | 5550-54                                              |               |                             |
| Filed as Large Entity                          |                 |                                                      |               |                             |
| <b>Utility under 35 USC 111(a) Filing Fees</b> |                 |                                                      |               |                             |
| <b>Description</b>                             | <b>Fee Code</b> | <b>Quantity</b>                                      | <b>Amount</b> | <b>Sub-Total in USD(\$)</b> |
| <b>Basic Filing:</b>                           |                 |                                                      |               |                             |
| <b>Pages:</b>                                  |                 |                                                      |               |                             |
| <b>Claims:</b>                                 |                 |                                                      |               |                             |
| <b>Miscellaneous-Filing:</b>                   |                 |                                                      |               |                             |
| <b>Petition:</b>                               |                 |                                                      |               |                             |
| <b>Patent-Appeals-and-Interference:</b>        |                 |                                                      |               |                             |
| <b>Post-Allowance-and-Post-Issuance:</b>       |                 |                                                      |               |                             |
| <b>Extension-of-Time:</b>                      |                 |                                                      |               |                             |
| Extension - 3 months with \$0 paid             | 1253            | 1                                                    | 1110          | 1110                        |

| Description       | Fee Code | Quantity | Amount | Sub-Total in USD(\$) |
|-------------------|----------|----------|--------|----------------------|
| Miscellaneous:    |          |          |        |                      |
| Total in USD (\$) |          |          |        | 1110                 |

| Electronic Acknowledgement Receipt          |                                                      |
|---------------------------------------------|------------------------------------------------------|
| <b>EFS ID:</b>                              | 5933059                                              |
| <b>Application Number:</b>                  | 11246163                                             |
| <b>International Application Number:</b>    |                                                      |
| <b>Confirmation Number:</b>                 | 5478                                                 |
| <b>Title of Invention:</b>                  | Resource sharing in a telecommunications environment |
| <b>First Named Inventor/Applicant Name:</b> | Marcos C. Tzannes                                    |
| <b>Customer Number:</b>                     | 62574                                                |
| <b>Filer:</b>                               | Jason Vick/Joanne Vos                                |
| <b>Filer Authorized By:</b>                 | Jason Vick                                           |
| <b>Attorney Docket Number:</b>              | 5550-54                                              |
| <b>Receipt Date:</b>                        | 21-AUG-2009                                          |
| <b>Filing Date:</b>                         | 11-OCT-2005                                          |
| <b>Time Stamp:</b>                          | 16:28:15                                             |
| <b>Application Type:</b>                    | Utility under 35 USC 111(a)                          |

### Payment information:

|                                                                                                                                                                                                                                                                                                                                                                                          |                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Submitted with Payment                                                                                                                                                                                                                                                                                                                                                                   | yes             |
| Payment Type                                                                                                                                                                                                                                                                                                                                                                             | Deposit Account |
| Payment was successfully received in RAM                                                                                                                                                                                                                                                                                                                                                 | \$1110          |
| RAM confirmation Number                                                                                                                                                                                                                                                                                                                                                                  | 1808            |
| Deposit Account                                                                                                                                                                                                                                                                                                                                                                          | 191970          |
| Authorized User                                                                                                                                                                                                                                                                                                                                                                          |                 |
| <p>The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:</p> <p>Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)</p> <p>Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)</p> |                 |

|                                                                                                   |                                                       |                        |                                                    |                  |                 |
|---------------------------------------------------------------------------------------------------|-------------------------------------------------------|------------------------|----------------------------------------------------|------------------|-----------------|
| Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)           |                                                       |                        |                                                    |                  |                 |
| Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges) |                                                       |                        |                                                    |                  |                 |
| File Listing:                                                                                     |                                                       |                        |                                                    |                  |                 |
| Document Number                                                                                   | Document Description                                  | File Name              | File Size(Bytes)/ Message Digest                   | Multi Part /.zip | Pages (if appl. |
| 1                                                                                                 |                                                       | F20090821_AMEND_01.pdf | 695796<br>4d49448b80cf218ad13da53773621234bee98ce3 | yes              | 9               |
|                                                                                                   | Multipart Description/PDF files in .zip description   |                        |                                                    |                  |                 |
|                                                                                                   | Document Description                                  |                        | Start                                              | End              |                 |
|                                                                                                   | Amendment/Req. Reconsideration-After Non-Final Reject |                        | 1                                                  | 1                |                 |
|                                                                                                   | Specification                                         |                        | 2                                                  | 2                |                 |
|                                                                                                   | Claims                                                |                        | 3                                                  | 7                |                 |
|                                                                                                   | Applicant Arguments/Remarks Made in an Amendment      |                        | 8                                                  | 9                |                 |
| Warnings:                                                                                         |                                                       |                        |                                                    |                  |                 |
| Information:                                                                                      |                                                       |                        |                                                    |                  |                 |
| 2                                                                                                 | Extension of Time                                     | F20090821_EOT_01.pdf   | 121899<br>d5d846a10f04906c3859631fb789bda9566d51da | no               | 1               |
| Warnings:                                                                                         |                                                       |                        |                                                    |                  |                 |
| Information:                                                                                      |                                                       |                        |                                                    |                  |                 |
| 3                                                                                                 | Fee Worksheet (PTO-875)                               | fee-info.pdf           | 29699<br>f37dcea9c75328cca3e5f322d94dc8bad113b84c  | no               | 2               |
| Warnings:                                                                                         |                                                       |                        |                                                    |                  |                 |
| Information:                                                                                      |                                                       |                        |                                                    |                  |                 |
| Total Files Size (in bytes):                                                                      |                                                       |                        | 847394                                             |                  |                 |

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

**New Applications Under 35 U.S.C. 111**

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

**National Stage of an International Application under 35 U.S.C. 371**

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

**New International Application Filed with the USPTO as a Receiving Office**

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

| <b>PATENT APPLICATION FEE DETERMINATION RECORD</b><br>Substitute for Form PTO-875                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                               |                                  |                                    |               | Application or Docket Number<br><b>11/246,163</b> |                     | Filing Date<br><b>10/11/2005</b> |                     | <input type="checkbox"/> To be Mailed |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|------------------------------------|---------------|---------------------------------------------------|---------------------|----------------------------------|---------------------|---------------------------------------|--|
| <b>APPLICATION AS FILED – PART I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                               |                                  |                                    |               |                                                   |                     |                                  |                     |                                       |  |
| (Column 1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                               |                                  | (Column 2)                         |               | SMALL ENTITY <input type="checkbox"/> OR          |                     | OTHER THAN SMALL ENTITY          |                     |                                       |  |
| FOR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | NUMBER FILED                                                                                                                                                                                                                  | NUMBER EXTRA                     | RATE (\$)                          | FEE (\$)      | RATE (\$)                                         | FEE (\$)            |                                  |                     |                                       |  |
| <input checked="" type="checkbox"/> BASIC FEE<br>(37 CFR 1.16(a), (b), or (c))                                                                                                                                                                                                                                                                                                                                                                                                                                          | N/A                                                                                                                                                                                                                           | N/A                              | N/A                                |               | N/A                                               | <b>300</b>          |                                  |                     |                                       |  |
| <input type="checkbox"/> SEARCH FEE<br>(37 CFR 1.16(k), (l), or (m))                                                                                                                                                                                                                                                                                                                                                                                                                                                    | N/A                                                                                                                                                                                                                           | N/A                              | N/A                                |               | N/A                                               |                     |                                  |                     |                                       |  |
| <input type="checkbox"/> EXAMINATION FEE<br>(37 CFR 1.16(o), (p), or (q))                                                                                                                                                                                                                                                                                                                                                                                                                                               | N/A                                                                                                                                                                                                                           | N/A                              | N/A                                |               | N/A                                               |                     |                                  |                     |                                       |  |
| TOTAL CLAIMS<br>(37 CFR 1.16(j))                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | minus 20 =                                                                                                                                                                                                                    | *                                | X \$ =                             |               | OR                                                | X \$ =              |                                  |                     |                                       |  |
| INDEPENDENT CLAIMS<br>(37 CFR 1.16(h))                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | minus 3 =                                                                                                                                                                                                                     | *                                | X \$ =                             |               | OR                                                | X \$ =              |                                  |                     |                                       |  |
| <input type="checkbox"/> APPLICATION SIZE FEE<br>(37 CFR 1.16(s))                                                                                                                                                                                                                                                                                                                                                                                                                                                       | If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s). |                                  |                                    |               |                                                   |                     |                                  |                     |                                       |  |
| <input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                               |                                  |                                    |               |                                                   |                     |                                  |                     |                                       |  |
| * If the difference in column 1 is less than zero, enter "0" in column 2.                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                               |                                  | TOTAL                              |               | TOTAL                                             | <b>300</b>          |                                  |                     |                                       |  |
| <b>APPLICATION AS AMENDED – PART II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                               |                                  |                                    |               |                                                   |                     |                                  |                     |                                       |  |
| (Column 1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                               |                                  | (Column 2)                         |               | (Column 3)                                        |                     | SMALL ENTITY OR                  |                     | OTHER THAN SMALL ENTITY               |  |
| <b>AMENDMENT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>08/21/2009</b>                                                                                                                                                                                                             | CLAIMS REMAINING AFTER AMENDMENT | HIGHEST NUMBER PREVIOUSLY PAID FOR | PRESENT EXTRA | RATE (\$)                                         | ADDITIONAL FEE (\$) | RATE (\$)                        | ADDITIONAL FEE (\$) |                                       |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Total (37 CFR 1.16(i))                                                                                                                                                                                                        | * 45                             | Minus                              | ** 45         | = 0                                               | X \$ =              | OR                               | X \$52=             | 0                                     |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Independent (37 CFR 1.16(h))                                                                                                                                                                                                  | * 5                              | Minus                              | ***5          | = 0                                               | X \$ =              | OR                               | X \$220=            | 0                                     |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))                                                                                                                                                                |                                  |                                    |               |                                                   |                     |                                  |                     |                                       |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))                                                                                                                                      |                                  |                                    |               |                                                   |                     |                                  |                     |                                       |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                               |                                  |                                    |               |                                                   | TOTAL ADD'L FEE     |                                  | TOTAL ADD'L FEE     | <b>0</b>                              |  |
| <b>AMENDMENT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Total (37 CFR 1.16(i))                                                                                                                                                                                                        | *                                | Minus                              | **            | =                                                 | X \$ =              | OR                               | X \$ =              |                                       |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Independent (37 CFR 1.16(h))                                                                                                                                                                                                  | *                                | Minus                              | ***           | =                                                 | X \$ =              | OR                               | X \$ =              |                                       |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))                                                                                                                                                                |                                  |                                    |               |                                                   |                     |                                  |                     |                                       |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))                                                                                                                                      |                                  |                                    |               |                                                   |                     |                                  |                     |                                       |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                               |                                  |                                    |               |                                                   | TOTAL ADD'L FEE     |                                  | TOTAL ADD'L FEE     |                                       |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                               |                                  |                                    |               |                                                   |                     |                                  |                     |                                       |  |
| <p>* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.</p> <p>** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".</p> <p>*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".</p> <p>The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.</p> <p style="text-align: right;">Legal Instrument Examiner:<br/>/GWENDOLYN MYERS/</p> |                                                                                                                                                                                                                               |                                  |                                    |               |                                                   |                     |                                  |                     |                                       |  |

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

| APPLICATION NO.                                                                         | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.             | CONFIRMATION NO.            |
|-----------------------------------------------------------------------------------------|-------------|----------------------|---------------------------------|-----------------------------|
| 11/246,163                                                                              | 10/11/2005  | Marcos C. Tzannes    | 5550-54                         | 5478                        |
| 62574                                                                                   | 7590        | 02/24/2009           |                                 |                             |
| Jason H. Vick<br>Sheridan Ross, PC<br>Suite # 1200<br>1560 Broadway<br>Denver, CO 80202 |             |                      | EXAMINER<br>LEUNG, JACK C       |                             |
|                                                                                         |             |                      | ART UNIT<br>2447                | PAPER NUMBER                |
|                                                                                         |             |                      | NOTIFICATION DATE<br>02/24/2009 | DELIVERY MODE<br>ELECTRONIC |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

jvick@sheridanross.com



|                              |                        |                     |  |
|------------------------------|------------------------|---------------------|--|
| <b>Office Action Summary</b> | <b>Application No.</b> | <b>Applicant(s)</b> |  |
|                              | 11/246,163             | TZANNES ET AL.      |  |
|                              | <b>Examiner</b>        | <b>Art Unit</b>     |  |
|                              | JACK LEUNG             | 2447                |  |

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1) ☒ Responsive to communication(s) filed on 11 October 2005.

2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4) ☒ Claim(s) 1-45 is/are pending in the application.

4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.

5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.

6) ☒ Claim(s) 1-45 is/are rejected.

7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.

8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

9) ☒ The specification is objected to by the Examiner.

10) ☒ The drawing(s) filed on 11 October 2005 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
     Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
     Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
     a) ☐ All    b) ☐ Some \* c) ☐ None of:  
         1. ☐ Certified copies of the priority documents have been received.  
         2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
         3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
     \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08)  
     Paper No(s)/Mail Date 5/17/2006, 5/23/2007.

4) ☐ Interview Summary (PTO-413)  
     Paper No(s)/Mail Date. \_\_\_\_\_.

5) ☐ Notice of Informal Patent Application

6) ☐ Other: \_\_\_\_\_.

**DETAILED ACTION**

1. Claims 1-45 are pending.

***Specification***

2. The disclosure is objected to because of the following informalities:
  - "...that can be allocated to one or more interleaves or deinterleavers." in section 8 of the specification should be replaced by "...that can be allocated to one or more interleavers or deinterleavers."
  - "...The latency path will require  $N \cdot D = 16 \cdot 255 = 16$  Kbytes of interleaver memory at the transmitter..." in section 48 should be replaced by "...The latency path will require  $N \cdot D = 255 \cdot 64 = 16$  Kbytes of interleaver memory at the transmitter..."
  - The specification fails to provide proper antecedent basis for "an information storage media" in claim 37. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o).

Appropriate correction is required.

***Claim Rejections - 35 USC § 101***

3. 35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

4. Claims 19-27 and 28-36 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

With respect to claim 19, the claim lacks the necessary physical articles or objects to constitute a machine or a manufacture within the meaning of 35 U.S.C. 101. They are clearly not a series of steps or acts to be a process nor are they a combination of chemical compounds to be a composition of matter. As such, they fail to fall within a statutory category. They are, at best, functional descriptive material per se. Claims 20-27 are likewise rejected.

With respect to claim 28, the claim lacks the necessary physical articles or objects to constitute a machine or a manufacture within the meaning of 35 U.S.C. 101. They are clearly not a series of steps or acts to be a process nor are they a combination of chemical compounds to be a composition of matter. As such, they fail to fall within a statutory category. They are, at best, functional descriptive material per se. Claims 29-36 are likewise rejected.

***Claim Rejections - 35 USC § 102***

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

6. Claims 1-45 are rejected under 35 U.S.C. 102(e) as being anticipated by Fadavi-Ardekani (U.S. Patent No. 6,707,822).

With respect to claim 1, Fadavi-Ardekani teaches a method for sharing resources in a transceiver (i.e., the IDIM of the transceiver can support different number of sessions; lines 3-5 in column 7) comprising: allocating a first portion of shared memory to a first latency path (i.e., 16 Kbytes is allocated for interleave, lines 25-30 in column 7) and allocating a second portion of the shared memory to a second latency path (i.e., 4 Kbytes is allocated for deinterleave, lines 25-30 in column 7).

With respect to claim 2, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes an interleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new interleave session may be added to an existing interleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 3, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave; lines 3-5 and 30-33 in column 7).

With respect to claim 4, Fadavi-Ardekani further teaches wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple

portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new deinterleave session may be added to an existing deinterleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 5, Fadavi-Ardekani further teaches transmitting to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 6, Fadavi-Ardekani further teaches receiving from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 7, Fadavi-Ardekani further teaches allocating a shared processing module to a plurality of coding and/or decoding modules (i.e., the FCI supports multiple ADSL sessions and performs various tasks on payload data including framing/de-framing, cyclic redundancy check generation/checking,

scrambling/descrambling, Reed-Solomon encoding/decoding, and interleaving/de-interleaving, lines 11-17 in column 6).

With respect to claim 8, Fadavi-Ardekani further teaches wherein the allocating of at least one portion of the shared memory is based on one or more communication parameters (i.e., the number of sessions supported is based on the size of the IDIM and the interleave depth, lines 3-5 and 30-33 in column 7).

With respect to claim 9, Fadavi-Ardekani further teaches wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (i.e., interleave depth, wherein the interleave depth is directly proportional to latency, lines 3-5 in column 7).

With respect to claim 10, Fadavi-Ardekani teaches a transceiver comprising: a first portion of shared memory that is allocated to a first latency path (i.e., 16 Kbytes is allocated for interleave, lines 25-30 in column 7); and a second portion of the shared memory that is allocated to a second latency path (i.e., 4 Kbytes is allocated for deinterleave, lines 25-30 in column 7).

With respect to claim 11, Fadavi-Ardekani further teaches further comprising: an allocation module designed to allocate the shared memory based on one or more communication parameters (i.e., the number of sessions supported is based on the size of the IDIM and the interleave depth, lines 3-5 and 30-33 in column 7).

With respect to claim 12, Fadavi-Ardekani further teaches wherein at least one of the communication parameters is a data rate, a latency, an INP value or a Bit Error Rate

(i.e., interleave depth, wherein the interleave depth is directly proportional to latency, lines 3-5 in column 7).

With respect to claim 13, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes an interleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new interleave session may be added to an existing interleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 14, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave; lines 3-5 and 30-33 in column 7).

With respect to claim 15, Fadavi-Ardekani further teaches wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new deinterleave session may be added to an existing deinterleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 16, Fadavi-Ardekani further teaches further comprising a shared resource management module designed to determine information that is transmitted to another transceiver, wherein the information is used to determine a

maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 17, Fadavi-Ardekani further teaches further comprising a shared resource management module designed to utilize information that is received from another transceiver, wherein the information is used to determine a maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 18, Fadavi-Ardekani further teaches further comprising a shared processing module designed to provide processing resources to a plurality of coding and/or decoding modules (i.e., the FCI supports multiple ADSL sessions and performs various tasks on payload data including framing/de-framing, cyclic redundancy check generation/checking, scrambling/descrambling, Reed-Solomon encoding/decoding, and interleaving/de-interleaving, lines 11-17 in column 6).

With respect to claim 19, Fadavi-Ardekani teaches a system for sharing resources in a transceiver (i.e., the IDIM of the transceiver can support different number of sessions; lines 3-5 in column 7) comprising: means for allocating a first portion of



shared memory to a first latency path (i.e., 16 Kbytes is allocated for interleave, lines 25-30 in column 7) and means for allocating a second portion of the shared memory to a second latency path (i.e., 4 Kbytes is allocated for deinterleave, lines 25-30 in column 7).

With respect to claim 20, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes an interleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new interleave session may be added to an existing interleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 21, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave; lines 3-5 and 30-33 in column 7).

With respect to claim 22, Fadavi-Ardekani further teaches wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new deinterleave session may be added to an existing deinterleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 23, Fadavi-Ardekani further teaches means for transmitting to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 24, Fadavi-Ardekani further teaches means for receiving from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 25, Fadavi-Ardekani further teaches means for allocating a shared processing module to a plurality of coding and/or decoding modules (i.e., the FCI supports multiple ADSL sessions and performs various tasks on payload data including framing/de-framing, cyclic redundancy check generation/checking, scrambling/descrambling, Reed-Solomon encoding/decoding, and interleaving/de-interleaving, lines 11-17 in column 6).

With respect to claim 26, Fadavi-Ardekani further teaches wherein the allocating of at least one portion of the shared memory is based on one or more communication

parameters (i.e., the number of sessions supported is based on the size of the IDIM and the interleave depth, lines 3-5 and 30-33 in column 7).

With respect to claim 27, Fadavi-Ardekani further teaches wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (i.e., interleave depth, wherein the interleave depth is directly proportional to latency, lines 3-5 in column 7).

With respect to claim 28, Fadavi-Ardekani teaches a protocol for sharing resources in a transceiver (i.e., the IDIM of the transceiver can support different number of sessions; lines 3-5 in column 7) comprising: allocating a first portion of shared memory to a first latency path (i.e., 16 Kbytes is allocated for interleave, lines 25-30 in column 7) and allocating a second portion of the shared memory to a second latency path (i.e., 4 Kbytes is allocated for deinterleave, lines 25-30 in column 7).

With respect to claim 29, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes an interleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new interleave session may be added to an existing interleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 30, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver (i.e., the size of the IDIM and the interleave depth may be modified to

allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave; lines 3-5 and 30-33 in column 7).

With respect to claim 31, Fadavi-Ardekani further teaches wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new deinterleave session may be added to an existing deinterleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 32, Fadavi-Ardekani further teaches transmitting to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 33, Fadavi-Ardekani further teaches receiving from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 34, Fadavi-Ardekani further teaches allocating a shared processing module to a plurality of coding and/or decoding modules (i.e., the FCI supports multiple ADSL sessions and performs various tasks on payload data including framing/de-framing, cyclic redundancy check generation/checking, scrambling/descrambling, Reed-Solomon encoding/decoding, and interleaving/de-interleaving, lines 11-17 in column 6).

With respect to claim 35, Fadavi-Ardekani further teaches wherein the allocating of at least one portion of the shared memory is based on one or more communication parameters (i.e., the number of sessions supported is based on the size of the IDIM and the interleave depth, lines 3-5 and 30-33 in column 7).

With respect to claim 36, Fadavi-Ardekani further teaches wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (i.e., interleave depth, wherein the interleave depth is directly proportional to latency, lines 3-5 in column 7).

With respect to claim 37, Fadavi-Ardekani teaches sharing of resources in a transceiver (i.e., the IDIM of the transceiver can support different number of sessions; lines 3-5 in column 7) comprising: information that allocates a first portion of shared memory to a first latency path (i.e., 16 Kbytes is allocated for interleave, lines 25-30 in column 7) and information that allocates a second portion of the shared memory to a second latency path (i.e., 4 Kbytes is allocated for deinterleave, lines 25-30 in column 7).

With respect to claim 38, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes an interleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new interleave session may be added to an existing interleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 39, Fadavi-Ardekani further teaches wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave; lines 3-5 and 30-33 in column 7).

With respect to claim 40, Fadavi-Ardekani further teaches wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver (i.e., the size of the IDIM and the interleave depth may be modified to allocate multiple portions, wherein each portion or session may be used for interleave or deinterleave. For example, a new deinterleave session may be added to an existing deinterleave session; lines 3-5 and 30-33 in column 7).

With respect to claim 41, Fadavi-Ardekani further teaches further comprising information that transmits to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein

overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 42, Fadavi-Ardekani further teaches further comprising information that receives from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated (i.e., the ADSL transceiver provides data to (and receives data from) several channels with the data grouped into frames that include both payload data bytes and overhead data bytes, wherein overhead data bytes may contain information that is used to determine a maximum amount of shared memory that can be allocated, lines 20-25 in column 2).

With respect to claim 43, Fadavi-Ardekani further teaches further comprising information that allocates a shared processing module to a plurality of coding and/or decoding modules (i.e., the FCI supports multiple ADSL sessions and performs various tasks on payload data including framing/de-framing, cyclic redundancy check generation/checking, scrambling/descrambling, Reed-Solomon encoding/decoding, and interleaving/de-interleaving, lines 11-17 in column 6).

With respect to claim 44, Fadavi-Ardekani further teaches wherein the allocating of at least one portion of the shared memory is based on one or more communication parameters (i.e., the number of sessions supported is based on the size of the IDIM and the interleave depth, lines 3-5 and 30-33 in column 7).

With respect to claim 45, Fadavi-Ardekani further teaches wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate

(i.e., interleave depth, wherein the interleave depth is directly proportional to latency, lines 3-5 in column 7).

***Conclusion***

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to JACK LEUNG whose telephone number is (571)270-7215. The examiner can normally be reached on Monday thru Friday, 7:30am - 5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, (James) Joon Hwang can be reached on 571-272-4036. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.



Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/JACK LEUNG/  
Examiner, Art Unit 4142  
1/6/09

/Joon H. Hwang/  
Supervisory Patent Examiner, Art Unit 2447

|                                   |                                       |                                                              |             |
|-----------------------------------|---------------------------------------|--------------------------------------------------------------|-------------|
| <b>Notice of References Cited</b> | Application/Control No.<br>11/246,163 | Applicant(s)/Patent Under<br>Reexamination<br>TZANNES ET AL. |             |
|                                   | Examiner<br>JACK LEUNG                | Art Unit<br>2447                                             | Page 1 of 1 |

**U.S. PATENT DOCUMENTS**

| * |   | Document Number<br>Country Code-Number-Kind Code | Date<br>MM-YYYY | Name                   | Classification |
|---|---|--------------------------------------------------|-----------------|------------------------|----------------|
| * | A | US-6,707,822                                     | 03-2004         | Fadavi-Ardekani et al. | 370/395.5      |
|   | B | US-                                              |                 |                        |                |
|   | C | US-                                              |                 |                        |                |
|   | D | US-                                              |                 |                        |                |
|   | E | US-                                              |                 |                        |                |
|   | F | US-                                              |                 |                        |                |
|   | G | US-                                              |                 |                        |                |
|   | H | US-                                              |                 |                        |                |
|   | I | US-                                              |                 |                        |                |
|   | J | US-                                              |                 |                        |                |
|   | K | US-                                              |                 |                        |                |
|   | L | US-                                              |                 |                        |                |
|   | M | US-                                              |                 |                        |                |

**FOREIGN PATENT DOCUMENTS**

| * |   | Document Number<br>Country Code-Number-Kind Code | Date<br>MM-YYYY | Country | Name | Classification |
|---|---|--------------------------------------------------|-----------------|---------|------|----------------|
|   | N |                                                  |                 |         |      |                |
|   | O |                                                  |                 |         |      |                |
|   | P |                                                  |                 |         |      |                |
|   | Q |                                                  |                 |         |      |                |
|   | R |                                                  |                 |         |      |                |
|   | S |                                                  |                 |         |      |                |
|   | T |                                                  |                 |         |      |                |

**NON-PATENT DOCUMENTS**

| * |   | Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages) |
|---|---|-------------------------------------------------------------------------------------------|
|   | U |                                                                                           |
|   | V |                                                                                           |
|   | W |                                                                                           |
|   | X |                                                                                           |

\*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)  
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

|                                                                                                                        |                                                |                                                                      |
|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------|
| <b><i>Index of Claims</i></b><br><br> | <b>Application/Control No.</b><br><br>11246163 | <b>Applicant(s)/Patent Under Reexamination</b><br><br>TZANNES ET AL. |
|                                                                                                                        | <b>Examiner</b><br><br>JACK LEUNG              | <b>Art Unit</b><br><br>2447                                          |

|   |                 |   |                   |   |                     |   |                 |
|---|-----------------|---|-------------------|---|---------------------|---|-----------------|
| ✓ | <b>Rejected</b> | - | <b>Cancelled</b>  | N | <b>Non-Elected</b>  | A | <b>Appeal</b>   |
| = | <b>Allowed</b>  | ÷ | <b>Restricted</b> | I | <b>Interference</b> | O | <b>Objected</b> |

| <input type="checkbox"/> Claims renumbered in the same order as presented by applicant |          |            |      |  |  |  |  |  |  | <input type="checkbox"/> CPA | <input type="checkbox"/> T.D. | <input type="checkbox"/> R.1.47 |
|----------------------------------------------------------------------------------------|----------|------------|------|--|--|--|--|--|--|------------------------------|-------------------------------|---------------------------------|
| CLAIM                                                                                  |          |            | DATE |  |  |  |  |  |  |                              |                               |                                 |
| Final                                                                                  | Original | 12/29/2008 |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 1        | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 2        | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 3        | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 4        | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 5        | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 6        | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 7        | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 8        | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 9        | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 10       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 11       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 12       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 13       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 14       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 15       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 16       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 17       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 18       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 19       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 20       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 21       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 22       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 23       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 24       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 25       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 26       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 27       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 28       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 29       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 30       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 31       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 32       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 33       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 34       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 35       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 36       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |

|                                                                                                                                |                                            |                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------------------------------------|
| <p align="center"><b>Index of Claims</b></p>  | <b>Application/Control No.</b><br>11246163 | <b>Applicant(s)/Patent Under Reexamination</b><br>TZANNES ET AL. |
|                                                                                                                                | <b>Examiner</b><br>JACK LEUNG              | <b>Art Unit</b><br>2447                                          |

|   |                 |   |                   |   |                     |   |                 |
|---|-----------------|---|-------------------|---|---------------------|---|-----------------|
| ✓ | <b>Rejected</b> | - | <b>Cancelled</b>  | N | <b>Non-Elected</b>  | A | <b>Appeal</b>   |
| = | <b>Allowed</b>  | ÷ | <b>Restricted</b> | I | <b>Interference</b> | O | <b>Objected</b> |

| <input type="checkbox"/> Claims renumbered in the same order as presented by applicant |          |            |      |  |  |  |  |  |  | <input type="checkbox"/> CPA | <input type="checkbox"/> T.D. | <input type="checkbox"/> R.1.47 |
|----------------------------------------------------------------------------------------|----------|------------|------|--|--|--|--|--|--|------------------------------|-------------------------------|---------------------------------|
| CLAIM                                                                                  |          |            | DATE |  |  |  |  |  |  |                              |                               |                                 |
| Final                                                                                  | Original | 12/29/2008 |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 37       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 38       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 39       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 40       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 41       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 42       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 43       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 44       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |
|                                                                                        | 45       | ✓          |      |  |  |  |  |  |  |                              |                               |                                 |

|                                                                                                              |                                                |                                                                      |
|--------------------------------------------------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------|
| <b>Search Notes</b><br><br> | <b>Application/Control No.</b><br><br>11246163 | <b>Applicant(s)/Patent Under Reexamination</b><br><br>TZANNES ET AL. |
|                                                                                                              | <b>Examiner</b><br><br>JACK LEUNG              | <b>Art Unit</b><br><br>2447                                          |

| SEARCHED |          |      |          |
|----------|----------|------|----------|
| Class    | Subclass | Date | Examiner |
|          |          |      |          |

| SEARCH NOTES                   |  |           |          |
|--------------------------------|--|-----------|----------|
| Search Notes                   |  | Date      | Examiner |
| PALM inventor searched         |  | Dec. 2008 | JL       |
| Class 709 using text search    |  | Dec. 2008 | JL       |
| See search history printout(s) |  | Dec. 2008 | JL       |

| INTERFERENCE SEARCH |          |      |          |
|---------------------|----------|------|----------|
| Class               | Subclass | Date | Examiner |
|                     |          |      |          |

|  |  |
|--|--|
|  |  |
|--|--|



## UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
 United States Patent and Trademark Office  
 Address: COMMISSIONER FOR PATENTS  
 P.O. Box 1450  
 Alexandria, Virginia 22313-1450  
 www.uspto.gov

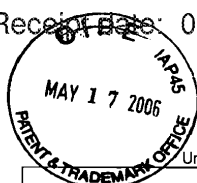
## BIB DATA SHEET

CONFIRMATION NO. 5478

| SERIAL NUMBER                                                                                                                                                                                                                                                                                    | FILING or 371(c)<br>DATE<br>RULE                                                                                  | CLASS                                                    | GROUP ART UNIT                | ATTORNEY DOCKET<br>NO.                                                                                                                                                                                                                                                    |                           |                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|--------------------------------|
| 11/246,163                                                                                                                                                                                                                                                                                       | 10/11/2005                                                                                                        | 711                                                      | 4142                          | T3653-9285US01                                                                                                                                                                                                                                                            |                           |                                |
| <b>APPLICANTS</b><br>Marcos C. Tzannes, Orinda, CA;<br>Michael Lund, West Newton, MA;<br><b>** CONTINUING DATA *****</b><br>This appln claims benefit of 60/618,269 10/12/2004<br><b>** FOREIGN APPLICATIONS *****</b><br><b>** IF REQUIRED, FOREIGN FILING LICENSE GRANTED **</b><br>11/07/2005 |                                                                                                                   |                                                          |                               |                                                                                                                                                                                                                                                                           |                           |                                |
| Foreign Priority claimed <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No<br>35 USC 119(a-d) conditions met <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No<br>Verified and Acknowledged <u>/JACK C LEUNG/</u><br>Examiner's Signature                    |                                                                                                                   | <input type="checkbox"/> Met after Allowance<br>Initials | <b>STATE OR COUNTRY</b><br>CA | <b>SHEETS DRAWINGS</b><br>3                                                                                                                                                                                                                                               | <b>TOTAL CLAIMS</b><br>45 | <b>INDEPENDENT CLAIMS</b><br>5 |
| <b>ADDRESS</b><br>Jason H. Vick<br>Sheridan Ross, PC<br>Suite # 1200<br>1560 Broadway<br>Denver, CO 80202<br>UNITED STATES                                                                                                                                                                       |                                                                                                                   |                                                          |                               |                                                                                                                                                                                                                                                                           |                           |                                |
| <b>TITLE</b><br>Resource sharing in a telecommunications environment                                                                                                                                                                                                                             |                                                                                                                   |                                                          |                               |                                                                                                                                                                                                                                                                           |                           |                                |
| <b>FILING FEE RECEIVED</b><br>2780                                                                                                                                                                                                                                                               | FEES: Authority has been given in Paper<br>No. _____ to charge/credit DEPOSIT ACCOUNT<br>No. _____ for following: |                                                          |                               | <input type="checkbox"/> All Fees<br><input type="checkbox"/> 1.16 Fees (Filing)<br><input type="checkbox"/> 1.17 Fees (Processing Ext. of time)<br><input type="checkbox"/> 1.18 Fees (Issue)<br><input type="checkbox"/> Other _____<br><input type="checkbox"/> Credit |                           |                                |

Receipt Date: 05/17/2006

11246163 - GAU: 4142



Please type a plus sign (+) inside this box → +

PTO/SB/08A (08-03)

Approved for use through 07/31/2006. OMB 0651-0031

U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

|                                                                                                   |      |                        |                    |
|---------------------------------------------------------------------------------------------------|------|------------------------|--------------------|
| Substitute for form 1449A/PTO                                                                     |      | Complete it Known      |                    |
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b><br><br>(use as many sheets as necessary) |      | Application Number     | 11/246,163         |
|                                                                                                   |      | Filing Date            | October 11, 2005   |
|                                                                                                   |      | First Named Inventor   | TZANNES, MARCOS C. |
|                                                                                                   |      | Art Unit               | 2186               |
|                                                                                                   |      | Examiner Name          |                    |
| Sheet 1                                                                                           | of 2 | Attorney Docket Number | T3653-9285US01     |

| U.S. PATENT DOCUMENTS |                          |                      |                                      |                                                    |                                |                                                                                 |
|-----------------------|--------------------------|----------------------|--------------------------------------|----------------------------------------------------|--------------------------------|---------------------------------------------------------------------------------|
| Examiner<br>Initials* | Cite<br>No. <sup>1</sup> | U.S. Patent Document |                                      | Name of Patentee or Applicant<br>of Cited Document | Publication Date<br>MM-DD-YYYY | Pages, Columns, Lines, Where<br>Relevant Passages or Relevant<br>Figures Appear |
|                       |                          | Number               | Kind Code <sup>2</sup><br>(if known) |                                                    |                                |                                                                                 |
|                       |                          | 6,337,877            |                                      | Cole et al.                                        | 01-08-2002                     |                                                                                 |
|                       |                          | 6,707,822            |                                      | Fadavi—Ardekani et al.                             | 03-16-2004                     |                                                                                 |
|                       |                          | 6,775,320            |                                      | Tzannes et al.                                     | 08-10-2004                     |                                                                                 |
|                       |                          | 6,778,589            |                                      | Ishii, Satoru                                      | 08-17-2004                     |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
|                       |                          |                      |                                      |                                                    |                                |                                                                                 |
| </                    |                          |                      |                                      |                                                    |                                |                                                                                 |

| FOREIGN PATENT DOCUMENTS |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|--------------------------|--------------------------|-------------------------|---------------------|--------------------------------------|-------------------------------------------------------|--------------------------------|---------------------------------------------------------------------------------|----------------|
| Examiner<br>Initials*    | Cite<br>No. <sup>1</sup> | Foreign Patent Document |                     |                                      | Name of Patentee or<br>Applicant<br>of Cited Document | Publication Date<br>MM-DD-YYYY | Pages, Columns, Lines, Where<br>Relevant Passages or Relevant<br>Figures Appear | T <sup>6</sup> |
|                          |                          | Office <sup>3</sup>     | Number <sup>4</sup> | Kind Code <sup>5</sup><br>(if known) |                                                       |                                |                                                                                 |                |
|                          |                          | WO                      | 2003/063060         | A                                    | Broadcom Corporation                                  | 07-31-2003                     |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |
|                          |                          |                         |                     |                                      |                                                       |                                |                                                                                 |                |

|                       |                    |
|-----------------------|--------------------|
| Examiner<br>Signature | Date<br>Considered |
|-----------------------|--------------------|

\* EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

<sup>1</sup> Unique citation designation number. <sup>2</sup> See attached Kinds of U.S. Patent Documents. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard St.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached. This collection of information is required by 37 CFR 1.97 and 1.98. This information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.L./

11246163 - GAU: 4142

PTO/SB/08A (08-03)

Approved for use through 07/31/2006. OMB 0651-0031

U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

|                                                                                                                                               |   |    |   |                        |                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------|---|----|---|------------------------|--------------------|
| <p>Substitute for form 1449A/PTO</p> <p><b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b></p> <p>(use as many sheets as necessary)</p> |   |    |   | Complete it Known      |                    |
|                                                                                                                                               |   |    |   | Application Number     | 11/246,163         |
|                                                                                                                                               |   |    |   | Filing Date            | October 11, 2005   |
|                                                                                                                                               |   |    |   | First Named Inventor   | TZANNES, MARCOS C. |
|                                                                                                                                               |   |    |   | Art Unit               | 2186               |
|                                                                                                                                               |   |    |   | Examiner Name          |                    |
|                                                                                                                                               |   |    |   |                        |                    |
| Sheet                                                                                                                                         | 2 | of | 2 | Attorney Docket Number | T3653-9285US01     |

[illegible]

|                       |              |                    |            |
|-----------------------|--------------|--------------------|------------|
| Examiner<br>Signature | /Jack Leung/ | Date<br>Considered | 01/06/2009 |
|-----------------------|--------------|--------------------|------------|

\* EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

<sup>1</sup> Unique citation designation number. <sup>2</sup> See attached Kinds of U.S. Patent Documents. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard St.3). <sup>4</sup> For Japanese patent, <sup>5</sup> Enter the Japanese Patent Office (JPO) number.

For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached. This collection of information is required by 37 CFR 1.97 and 1.98. This information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.L./



Receipt date: 05/23/2007

11246163 - GAU: 4142

PTO/SB/08a (08-03)

Approved for use through 07/31/2006. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

|                                                                                                     |                        |                    |
|-----------------------------------------------------------------------------------------------------|------------------------|--------------------|
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b><br>( Not for submission under 37 CFR 1.99) | Application Number     | 11246163           |
|                                                                                                     | Filing Date            | 2005-10-11         |
|                                                                                                     | First Named Inventor   | Tzannes            |
|                                                                                                     | Art Unit               | 2142               |
|                                                                                                     | Examiner Name          | CALDWELL, ANDREW T |
|                                                                                                     | Attorney Docket Number | 5550-54            |

| U.S. PATENTS <span>Remove</span> |         |               |                        |            |                                                 |                                                                          |
|----------------------------------|---------|---------------|------------------------|------------|-------------------------------------------------|--------------------------------------------------------------------------|
| Examiner Initial*                | Cite No | Patent Number | Kind Code <sup>1</sup> | Issue Date | Name of Patentee or Applicant of cited Document | Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear |
|                                  | 1       | 6778596       |                        | 2004-08-17 | Tzannes                                         |                                                                          |

If you wish to add additional U.S. Patent citation information please click the Add button.

Add

| U.S. PATENT APPLICATION PUBLICATIONS <span>Remove</span> |         |                    |                        |                  |                                                 |                                                                          |
|----------------------------------------------------------|---------|--------------------|------------------------|------------------|-------------------------------------------------|--------------------------------------------------------------------------|
| Examiner Initial*                                        | Cite No | Publication Number | Kind Code <sup>1</sup> | Publication Date | Name of Patentee or Applicant of cited Document | Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear |
|                                                          | 1       |                    |                        |                  |                                                 |                                                                          |

If you wish to add additional U.S. Published Application citation information please click the Add button.

Add

| FOREIGN PATENT DOCUMENTS <span>Remove</span> |         |                                      |                             |                        |                  |                                                 |                                                                          |
|----------------------------------------------|---------|--------------------------------------|-----------------------------|------------------------|------------------|-------------------------------------------------|--------------------------------------------------------------------------|
| Examiner Initial*                            | Cite No | Foreign Document Number <sup>3</sup> | Country Code <sup>2</sup> j | Kind Code <sup>4</sup> | Publication Date | Name of Patentee or Applicant of cited Document | Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear |
|                                              | 1       |                                      |                             |                        |                  |                                                 | <input type="checkbox"/>                                                 |

If you wish to add additional Foreign Patent Document citation information please click the Add button.

Add

| NON-PATENT LITERATURE DOCUMENTS <span>Remove</span> |         |                                                                                                                                                                                                                                                                 |
|-----------------------------------------------------|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Examiner Initials*                                  | Cite No | Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published. |
|                                                     |         |                                                                                                                                                                                                                                                                 |

Receipt date: 05/23/2007

**INFORMATION DISCLOSURE  
STATEMENT BY APPLICANT**  
( Not for submission under 37 CFR 1.99)

|                        |                    |                      |
|------------------------|--------------------|----------------------|
| Application Number     | 11246163           | 11246163 - GAU: 4142 |
| Filing Date            | 2005-10-11         |                      |
| First Named Inventor   | Tzannes            |                      |
| Art Unit               | 2142               |                      |
| Examiner Name          | CALDWELL, ANDREW T |                      |
| Attorney Docket Number | 5550-54            |                      |

|   |                                                                                                                                           |                          |
|---|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| 1 | Written Opinion for International (PCT) Patent Application No. PCT/US2005/036015, mailed February 8, 2006                                 | <input type="checkbox"/> |
| 2 | International Preliminary Report on Patentability for International (PCT) Patent Application No. PCT/US2005/036015, mailed April 26, 2007 | <input type="checkbox"/> |

If you wish to add additional non-patent literature document citation information please click the Add button

|                           |              |                 |            |
|---------------------------|--------------|-----------------|------------|
| <b>EXAMINER SIGNATURE</b> |              |                 |            |
| Examiner Signature        | /Jack Leung/ | Date Considered | 01/06/2009 |

\*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

<sup>1</sup> See Kind Codes of USPTO Patent Documents at [www.USPTO.GOV](http://www.USPTO.GOV) or MPEP 901.04. <sup>2</sup> Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). <sup>3</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>4</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. <sup>5</sup> Applicant is to place a check mark here if English language translation is attached.

## EAST Search History

| Ref # | Hits | Search Query                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | DBs                                                     | Default Operator | Plurals | Time Stamp          |
|-------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|------------------|---------|---------------------|
| S1    | 3    | "6707822".pn.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR               | OFF     | 2008/12/22<br>10:39 |
| S2    | 4    | "03063060"                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR               | OFF     | 2008/12/22<br>10:44 |
| S3    | 2    | "6337877".pn.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR               | OFF     | 2008/12/22<br>10:49 |
| S4    | 8    | "6778596"                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR               | OFF     | 2008/12/22<br>13:27 |
| S5    | 2    | "6778596".pn.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR               | OFF     | 2008/12/22<br>13:27 |
| S6    | 38   | ("3573380"   "4131766"  <br>"4568156"   "4679227"  <br>"4731816"   "4802190"  <br>"4912763"   "5048054"  <br>"5128964"   "5206886"  <br>"5285474"   "5327574"  <br>"5400322"   "5428790"  <br>"5452288"   "5479447"  <br>"5497398"   "5521906"  <br>"5533008"   "5555244"  <br>"5596604"   "5598435"  <br>"5625651"   "5636246"  <br>"5644573"   "5682419"  <br>"5812599"   "5822372"  <br>"5822374"   "5910959"  <br>"6009122"   "6011814"  <br>"6052411"   "6072779"  <br>"6084917"   "6188729"  <br>"6480475"   "6665872").PN. | US-PGPUB;<br>USPAT; USOCR                               | OR               | OFF     | 2008/12/22<br>13:28 |
| S7    | 2    | "20060088054"                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR               | OFF     | 2008/12/22<br>13:46 |

|     |      |                                                                                                                                                |                                                         |    |     |                     |
|-----|------|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|----|-----|---------------------|
| S8  | 2    | "7146391".pn.                                                                                                                                  | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/29<br>08:38 |
| S9  | 2    | "20060088054"                                                                                                                                  | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/29<br>08:40 |
| S10 | 1    | (allocat\$3 near4 (two near4<br>portion\$1)) near4 (shared<br>adj memory) same (latency<br>paths) same (interleavers)<br>same (deinterleavers) | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/29<br>08:47 |
| S11 | 1    | (allocat\$3 near4 (two near4<br>portion\$1)) near4 (shared<br>adj memory) same (latency<br>paths) same (interleav\$4)<br>same (deinterleav\$4) | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/29<br>08:47 |
| S12 | 1    | (allocat\$3 near4 (two near4<br>portion\$1)) with (shared adj<br>memory) same (latency<br>paths) and (interleav\$4)<br>and (deinterleav\$4)    | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/29<br>08:48 |
| S13 | 2    | ((two near4 portion\$1))<br>with (shared adj memory)<br>same (latency paths) and<br>(interleav\$4) and<br>(deinterleav\$4)                     | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/29<br>08:49 |
| S14 | 3    | ((two near4 portion\$1))<br>with (memory) same<br>(latency paths) and<br>(interleav\$4) and<br>(deinterleav\$4)                                | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/29<br>08:49 |
| S15 | 2    | "6775320".pn.                                                                                                                                  | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/29<br>09:31 |
| S16 | 0    | "707"/\$.709/<br>\$.711/147,169,708/\$.ccls.                                                                                                   | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/29<br>10:06 |
| S17 | 2208 | 711/147,169.ccls.                                                                                                                              | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/29<br>10:06 |

## EAST Search History

|     |      |                                                                                         |                                                         |    |     |                     |
|-----|------|-----------------------------------------------------------------------------------------|---------------------------------------------------------|----|-----|---------------------|
| S18 | 1    | S17 and (shar\$3 near3 memory) with (laten\$4 adj path\$1)                              | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/29<br>10:07 |
| S19 | 1    | S17 and ((shar\$3 or allocat \$4 or manag\$4) near3 memory) with (laten\$4 adj path\$1) | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/29<br>10:08 |
| S20 | 1    | S17 and ((shar\$3 or allocat \$4 or manag\$4) near3 memory) same (laten\$4 adj path\$1) | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/29<br>10:08 |
| S21 | 1255 | S17 and ((shar\$3 or allocat \$4 or manag\$4) near3 memory)                             | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/29<br>10:09 |
| S22 | 1034 | S17 and ((shar\$3) near3 memory)                                                        | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/29<br>10:09 |
| S23 | 495  | S17 and ((allocat\$3) near3 memory)                                                     | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/29<br>10:09 |
| S24 | 25   | S17 and (((two or "2") adj (portion\$1 or segment\$1)) near4 memory)                    | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/29<br>10:12 |
| S25 | 2    | "6778589".pn.                                                                           | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/29<br>11:23 |
| S26 | 0    | "455".ccls.                                                                             | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/30<br>08:41 |
| S27 | 0    | "455/\$".ccls.                                                                          | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/30<br>08:41 |

|     |        |                                                                                              |                                                         |    |     |                     |
|-----|--------|----------------------------------------------------------------------------------------------|---------------------------------------------------------|----|-----|---------------------|
| S28 | 129337 | "455"/\$.cls.                                                                                | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | OFF | 2008/12/30<br>08:41 |
| S29 | 0      | S28 and (latency adj path<br>\$1).ti,ab.                                                     | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | ON  | 2008/12/30<br>08:42 |
| S30 | 41     | (latency adj path\$1).ti,ab.                                                                 | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | ON  | 2008/12/30<br>08:42 |
| S31 | 3      | "20030091053"                                                                                | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | ON  | 2008/12/31<br>11:24 |
| S32 | 61025  | ((bit adj error adj (rate or<br>ratio)) or ber)                                              | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | ON  | 2009/01/05<br>14:18 |
| S33 | 2962   | 370/468.cls.                                                                                 | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | ON  | 2009/01/05<br>14:20 |
| S34 | 254    | S32 and S33                                                                                  | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | ON  | 2009/01/05<br>14:20 |
| S35 | 672    | ((bit adj error adj (rate or<br>ratio)) or ber) with allocat\$3                              | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | ON  | 2009/01/05<br>14:20 |
| S36 | 12     | S33 and S35                                                                                  | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | ON  | 2009/01/05<br>14:21 |
| S37 | 1186   | ((bit adj error adj (rate or<br>ratio)) or ber) same<br>(interleav\$3 or deinterleav<br>\$3) | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | ON  | 2009/01/05<br>14:38 |

|     |       |                                                                                                                                                  |                                                                   |    |    |                     |
|-----|-------|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|----|----|---------------------|
| S38 | 44    | ((bit adj error adj (rate or ratio)) or ber) same (interleav\$3 or deinterleav \$3) same (latency)                                               | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB           | OR | ON | 2009/01/05<br>14:38 |
| S39 | 1     | S33 and S38                                                                                                                                      | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB           | OR | ON | 2009/01/05<br>14:38 |
| S40 | 16    | ((bit adj error adj (rate or ratio)) or ber) same (interleav\$3 or deinterleav \$3) same (latency) same path\$1                                  | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB           | OR | ON | 2009/01/05<br>14:39 |
| S41 | 1     | ((bit adj error adj (rate or ratio)) or ber) same (interleav\$3 or deinterleav \$3) same (allocat\$3 near4 (memory or buffer\$1))                | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB           | OR | ON | 2009/01/05<br>15:09 |
| S42 | 1     | ((bit adj error adj (rate or ratio)) or ber) same (interleav\$3 or deinterleav \$3) same ((allocat\$3 or assign\$3) near4 (memory or buffer\$1)) | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB           | OR | ON | 2009/01/05<br>15:09 |
| S43 | 104   | ((bit adj error adj (rate or ratio)) or ber) same (interleav\$3 or deinterleav \$3) same ((memory or buffer\$1))                                 | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB           | OR | ON | 2009/01/05<br>15:10 |
| S44 | 3     | ((bit adj error adj (rate or ratio)) or ber) same (interleav\$3 or deinterleav \$3) same (shar\$3 with (memory or buffer\$1))                    | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB           | OR | ON | 2009/01/05<br>15:10 |
| S45 | 3     | "20030225808"                                                                                                                                    | US-PGPUB;<br>USPAT; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB           | OR | ON | 2009/01/06<br>09:32 |
| S46 | 49583 | "711"/\$.ccls.                                                                                                                                   | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | ON | 2009/02/03<br>14:57 |
| S47 | 139   | S46 and ((shar\$3 near (buffer or memory)) and ((latency adj path\$1) or channel\$1 or \$3interleav \$3)).ti,ab.                                 | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | ON | 2009/02/03<br>14:57 |

## EAST Search History

|     |      |                       |                                                                   |    |    |                     |
|-----|------|-----------------------|-------------------------------------------------------------------|----|----|---------------------|
| S48 | 2161 | 709/213,214,215.ccls. | US-PGPUB;<br>USPAT;<br>USOCR; EPO;<br>JPO;<br>DERWENT;<br>IBM_TDB | OR | ON | 2009/02/09<br>17:15 |
|-----|------|-----------------------|-------------------------------------------------------------------|----|----|---------------------|

2/ 11/ 2009 11:05:42 AM

C:\Documents and Settings\jleung2\My Documents\EAST\Workspaces\2008  
\11246163\_trans\_res\_sharing.wsp



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

|                             |   |                        |
|-----------------------------|---|------------------------|
| In Re the Application of:   | ) | Group Art Unit: 2142   |
|                             | ) |                        |
| TZANNES                     | ) | Confirmation No.: 5478 |
|                             | ) |                        |
| Application No.: 11/246,163 | ) |                        |
|                             | ) |                        |
| Filed: 10/11/2005           | ) |                        |
|                             | ) |                        |
| Atty. File No.: 5550-54     | ) |                        |
|                             | ) |                        |
| For: "RESOURCE SHARING IN A | ) |                        |
| TELECOMMUNICATIONS "        | ) |                        |
| ENVIRONMENT"                | ) |                        |

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313

PRELIMINARY AMENDMENT

Dear Sir:

Prior to the initial review of the above-identified patent application by the Examiner, please enter the following Preliminary Amendment. Although Applicants do not believe that any fees are due based upon the filing of this Preliminary Amendment, please charge any such fees to Deposit Account 19-1970.

Please amend the above-identified patent application as follows:

AMENDMENTS TO THE SPECIFICATION:

Please amend the Specification beginning as follows:

[0003] U.S. Patent Nos. 6,775,320 and 6,778,589, ~~which are both incorporated herein by reference in their entirety,~~ describe DSL systems supporting multiple applications and multiple framer/coder/interleaver FCI blocks (an FCI block is also referred to as a latency path). DSL systems carry applications that have different transmission requirements with regard to, for example, data rate, latency (delay), bit error rate (BER), and the like. For example, video typically requires a low BER ( $<1E-10$ ) but can tolerate higher latency ( $>20$  ms). Voice, on the other hand, typically requires a low latency ( $<1$  ms) but can tolerate BER ( $>1E-3$ ).

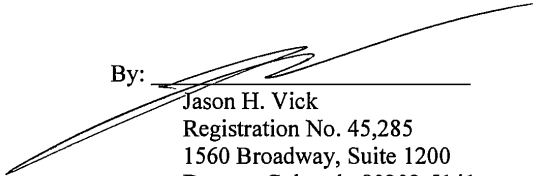
REMARKS/ARGUMENTS

Applicant requests examination on the merits.

Applicant believes that the pending claim is in condition for allowance and such disposition is respectfully requested. In the event that a telephone conversation would further prosecution and/or expedite allowance, the Examiner is invited to contact the undersigned.

Respectfully submitted,

SHERIDAN ROSS P.C.

By: 

Jason H. Vick  
Registration No. 45,285  
1560 Broadway, Suite 1200  
Denver, Colorado 80202-5141  
(303) 863-9700

Date: 17 Feb '11

J:\5550\12\DIV\CON\AMEND\_PRELIM\_01.doc

| Electronic Acknowledgement Receipt   |                                                      |
|--------------------------------------|------------------------------------------------------|
| EFS ID:                              | 4794020                                              |
| Application Number:                  | 11246163                                             |
| International Application Number:    |                                                      |
| Confirmation Number:                 | 5478                                                 |
| Title of Invention:                  | Resource sharing in a telecommunications environment |
| First Named Inventor/Applicant Name: | Marcos C. Tzannes                                    |
| Customer Number:                     | 62574                                                |
| Filer:                               | Jason Vick/Christine Jacquet                         |
| Filer Authorized By:                 | Jason Vick                                           |
| Attorney Docket Number:              | T3653-9285US01                                       |
| Receipt Date:                        | 13-FEB-2009                                          |
| Filing Date:                         | 11-OCT-2005                                          |
| Time Stamp:                          | 17:11:26                                             |
| Application Type:                    | Utility under 35 USC 111(a)                          |

**Payment information:**

|                        |    |
|------------------------|----|
| Submitted with Payment | no |
|------------------------|----|

**File Listing:**

| Document Number | Document Description | File Name        | File Size(Bytes)/<br>Message Digest                               | Multi Part /.zip | Pages (if appl.) |
|-----------------|----------------------|------------------|-------------------------------------------------------------------|------------------|------------------|
| 1               |                      | PRELIM_AMEND.pdf | 132625<br><small>0e19a7af0e0d495c5847cd9b06e2dfb47e903000</small> | yes              | 3                |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Multipart Description/PDF files in .zip description |        |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|--------|-----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Document Description                                | Start  | End |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Preliminary Amendment                               | 1      | 1   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Specification                                       | 2      | 2   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Applicant Arguments/Remarks Made in an Amendment    | 3      | 3   |
| <b>Warnings:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                     |        |     |
| <b>Information:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                     |        |     |
| <b>Total Files Size (in bytes):</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                     | 132625 |     |
| <p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><b><u>New Applications Under 35 U.S.C. 111</u></b><br/> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><b><u>National Stage of an International Application under 35 U.S.C. 371</u></b><br/> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><b><u>New International Application Filed with the USPTO as a Receiving Office</u></b><br/> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p> |                                                     |        |     |

|                                                                                                     |                        |                    |            |
|-----------------------------------------------------------------------------------------------------|------------------------|--------------------|------------|
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b><br>( Not for submission under 37 CFR 1.99) | Application Number     |                    | 11246163   |
|                                                                                                     | Filing Date            |                    | 2005-10-11 |
|                                                                                                     | First Named Inventor   | Tzannes            |            |
|                                                                                                     | Art Unit               | 2142               |            |
|                                                                                                     | Examiner Name          | CALDWELL, ANDREW T |            |
|                                                                                                     | Attorney Docket Number | 5550-54            |            |

| <b>U.S.PATENTS</b>                                                                                         |         |                                                                                                                                                                                                                                                                 |                             |                        |                                                 |                                                                        | <a href="#">Remove</a>                                                 |                          |
|------------------------------------------------------------------------------------------------------------|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------|-------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------------------------|--------------------------|
| Examiner Initial*                                                                                          | Cite No | Patent Number                                                                                                                                                                                                                                                   | Kind Code <sup>1</sup>      | Issue Date             | Name of Patentee or Applicant of cited Document | Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear |                                                                        |                          |
|                                                                                                            | 1       | 6778596                                                                                                                                                                                                                                                         |                             | 2004-08-17             | Tzannes                                         |                                                                        |                                                                        |                          |
| If you wish to add additional U.S. Patent citation information please click the Add button.                |         |                                                                                                                                                                                                                                                                 |                             |                        |                                                 |                                                                        | <a href="#">Add</a>                                                    |                          |
| <b>U.S.PATENT APPLICATION PUBLICATIONS</b>                                                                 |         |                                                                                                                                                                                                                                                                 |                             |                        |                                                 |                                                                        | <a href="#">Remove</a>                                                 |                          |
| Examiner Initial*                                                                                          | Cite No | Publication Number                                                                                                                                                                                                                                              | Kind Code <sup>1</sup>      | Publication Date       | Name of Patentee or Applicant of cited Document | Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear |                                                                        |                          |
|                                                                                                            | 1       |                                                                                                                                                                                                                                                                 |                             |                        |                                                 |                                                                        |                                                                        |                          |
| If you wish to add additional U.S. Published Application citation information please click the Add button. |         |                                                                                                                                                                                                                                                                 |                             |                        |                                                 |                                                                        | <a href="#">Add</a>                                                    |                          |
| <b>FOREIGN PATENT DOCUMENTS</b>                                                                            |         |                                                                                                                                                                                                                                                                 |                             |                        |                                                 |                                                                        | <a href="#">Remove</a>                                                 |                          |
| Examiner Initial*                                                                                          | Cite No | Foreign Document Number <sup>3</sup>                                                                                                                                                                                                                            | Country Code <sup>2</sup> j | Kind Code <sup>4</sup> | Publication Date                                | Name of Patentee or Applicant of cited Document                        | Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear | T <sup>5</sup>           |
|                                                                                                            | 1       |                                                                                                                                                                                                                                                                 |                             |                        |                                                 |                                                                        |                                                                        | <input type="checkbox"/> |
| If you wish to add additional Foreign Patent Document citation information please click the Add button     |         |                                                                                                                                                                                                                                                                 |                             |                        |                                                 |                                                                        | <a href="#">Add</a>                                                    |                          |
| <b>NON-PATENT LITERATURE DOCUMENTS</b>                                                                     |         |                                                                                                                                                                                                                                                                 |                             |                        |                                                 |                                                                        | <a href="#">Remove</a>                                                 |                          |
| Examiner Initials*                                                                                         | Cite No | Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published. |                             |                        |                                                 |                                                                        |                                                                        | T <sup>5</sup>           |

|                                                                                                     |                        |                    |            |
|-----------------------------------------------------------------------------------------------------|------------------------|--------------------|------------|
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b><br>( Not for submission under 37 CFR 1.99) | Application Number     |                    | 11246163   |
|                                                                                                     | Filing Date            |                    | 2005-10-11 |
|                                                                                                     | First Named Inventor   | Tzannes            |            |
|                                                                                                     | Art Unit               | 2142               |            |
|                                                                                                     | Examiner Name          | CALDWELL, ANDREW T |            |
|                                                                                                     | Attorney Docket Number | 5550-54            |            |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                           |                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Written Opinion for International (PCT) Patent Application No. PCT/US2005/036015, mailed February 8, 2006                                 | <input type="checkbox"/> |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | International Preliminary Report on Patentability for International (PCT) Patent Application No. PCT/US2005/036015, mailed April 26, 2007 | <input type="checkbox"/> |
| If you wish to add additional non-patent literature document citation information please click the Add button <input type="button" value="Add"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                           |                          |
| <b>EXAMINER SIGNATURE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                           |                          |
| Examiner Signature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                           | Date Considered          |
| *EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                           |                          |
| <small> <sup>1</sup> See Kind Codes of USPTO Patent Documents at <a href="http://www.USPTO.GOV">www.USPTO.GOV</a> or MPEP 901.04. <sup>2</sup> Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). <sup>3</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>4</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. <sup>5</sup> Applicant is to place a check mark here if English language translation is attached.         </small> |                                                                                                                                           |                          |

|                                                                                                     |                        |                    |
|-----------------------------------------------------------------------------------------------------|------------------------|--------------------|
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b><br>( Not for submission under 37 CFR 1.99) | Application Number     | 11246163           |
|                                                                                                     | Filing Date            | 2005-10-11         |
|                                                                                                     | First Named Inventor   | Tzannes            |
|                                                                                                     | Art Unit               | 2142               |
|                                                                                                     | Examiner Name          | CALDWELL, ANDREW T |
|                                                                                                     | Attorney Docket Number | 5550-54            |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                     |            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------------|------------|
| <b>CERTIFICATION STATEMENT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |                     |            |
| Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                 |                     |            |
| <input type="checkbox"/> That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |                     |            |
| <b>OR</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                 |                     |            |
| <input type="checkbox"/> That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).                                                                                                                                                                                                                                                                                                                                                          |                 |                     |            |
| <input type="checkbox"/> See attached certification statement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |                     |            |
| <input type="checkbox"/> Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |                     |            |
| <input checked="" type="checkbox"/> None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                 |                     |            |
| <b>SIGNATURE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                 |                     |            |
| A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                 |                     |            |
| Signature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | /Jason H. Vick/ | Date (YYYY-MM-DD)   | 2007-05-23 |
| Name/Print                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Jason H. Vick   | Registration Number | 45285      |
| <p>This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. <b>SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.</b></p> |                 |                     |            |



## Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

| Electronic Acknowledgement Receipt   |                                                      |
|--------------------------------------|------------------------------------------------------|
| EFS ID:                              | 1802698                                              |
| Application Number:                  | 11246163                                             |
| International Application Number:    |                                                      |
| Confirmation Number:                 | 5478                                                 |
| Title of Invention:                  | Resource sharing in a telecommunications environment |
| First Named Inventor/Applicant Name: | Marcos C. Tzannes                                    |
| Customer Number:                     | 62574                                                |
| Filer:                               | Jason Vick/Debra Kesner                              |
| Filer Authorized By:                 | Jason Vick                                           |
| Attorney Docket Number:              | T3653-9285US01                                       |
| Receipt Date:                        | 23-MAY-2007                                          |
| Filing Date:                         | 11-OCT-2005                                          |
| Time Stamp:                          | 11:38:01                                             |
| Application Type:                    | Utility                                              |

**Payment information:**

|                        |    |
|------------------------|----|
| Submitted with Payment | no |
|------------------------|----|

**File Listing:**

| Document Number | Document Description                         | File Name  | File Size(Bytes) | Multi Part /.zip | Pages (if appl.) |
|-----------------|----------------------------------------------|------------|------------------|------------------|------------------|
| 1               | Information Disclosure Statement (IDS) Filed | IDS_02.pdf | 666602           | no               | 4                |

**Warnings:**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |                                 |         |    |    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------------------------|---------|----|----|
| <b>Information:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |               |                                 |         |    |    |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | NPL Documents | 5550-54-PCT_Written_Opinion.pdf | 983104  | no | 9  |
| <b>Warnings:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                                 |         |    |    |
| <b>Information:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |               |                                 |         |    |    |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | NPL Documents | 5550-54-PCT_IPER.pdf            | 1236891 | no | 11 |
| <b>Warnings:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                                 |         |    |    |
| <b>Information:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |               |                                 |         |    |    |
| <b>Total Files Size (in bytes):</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |               |                                 | 2886597 |    |    |
| <p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><b><u>New Applications Under 35 U.S.C. 111</u></b><br/> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><b><u>National Stage of an International Application under 35 U.S.C. 371</u></b><br/> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><b><u>New International Application Filed with the USPTO as a Receiving Office</u></b><br/> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p> |               |                                 |         |    |    |



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

| APPLICATION NUMBER | PATENT NUMBER | GROUP ART UNIT | FILE WRAPPER LOCATION |
|--------------------|---------------|----------------|-----------------------|
| 11/246,163         |               | 2152           | 2157                  |

## Correspondence Address / Fee Address Change

The following fields have been set to Customer Number 62574 on 09/01/2006

- Correspondence Address
- Maintenance Fee Address

The address of record for Customer Number 62574 is:

SHERIDAN ROSS P C  
SUITE 1200  
1560 BROADWAY  
DENVER,CO 80202



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

| APPLICATION NUMBER | PATENT NUMBER | GROUP ART UNIT | FILE WRAPPER LOCATION |
|--------------------|---------------|----------------|-----------------------|
| 11/246,163         |               | 2152           | 2157                  |

## Correspondence Address / Fee Address Change

The following fields have been set to Customer Number 62574 on 08/10/2006

- Correspondence Address
- Maintenance Fee Address

The address of record for Customer Number 62574 is:

JASON H. VICK  
SUITE 500  
1751 PINNACLE DRIVE  
MCLEAN, VA 22102-3833



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

| APPLICATION NUMBER | PATENT NUMBER | GROUP ART UNIT | FILE WRAPPER LOCATION |
|--------------------|---------------|----------------|-----------------------|
| 11/246,163         |               | 2186           | 2157                  |

## Correspondence Address / Fee Address Change

The following fields have been set to Customer Number 62574 on 08/02/2006

- Correspondence Address
- Maintenance Fee Address

The address of record for Customer Number 62574 is:

JASON H. VICK  
SUITE 500  
1751 PINNACLE DRIVE  
MCLEAN, VA 22102-3833



Attorney Docket No. T3653-9285US01

gaw

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Patent Application of:

First Named Inventor: TZANNES, MARCOS C.

**Art Unit: 2186**

Application No.: 11/246,163

**Examiner:**

Filed: October 11, 2005

**Confirmation No.: 5478**

For: SHARING MEMORY AND PROCESSING  
RESOURCES IN DSL SYSTEMS

\* \* \*

**INFORMATION DISCLOSURE STATEMENT**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

Pursuant to 37 C.F.R. § 1.56, and without any assertion as to materiality or prior art effect, the documents listed on the attached Form PTO/SB/08A are hereby cited.

The Commissioner is hereby authorized to charge to Deposit Account No. 50-1165 (T3653-9285US01) any fees under 37 C.F.R. §§ 1.16 and 1.17 that may be required by this paper and to credit any overpayment to that Account. If any extension of time is required in connection with the filing of this paper and has not been separately requested, such extension is hereby requested.

Respectfully submitted,

Date: May 17, 2006

By: \_\_\_\_\_

Jason H. Vick  
Reg. No. 45,285

Miles & Stockbridge, P.C.  
1751 Pinnacle Drive  
Suite 500  
McLean, Virginia 22102-3833  
(703) 903-9000





PTO/SB/08A (08-03)

Approved for use through 07/31/2006. OMB 0651-0031

U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

|                                                                                                   |   |    |   |                        |                    |
|---------------------------------------------------------------------------------------------------|---|----|---|------------------------|--------------------|
| Substitute for form 1449A/PTO                                                                     |   |    |   | Complete it Known      |                    |
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b><br><br>(use as many sheets as necessary) |   |    |   | Application Number     | 11/246,163         |
|                                                                                                   |   |    |   | Filing Date            | October 11, 2005   |
|                                                                                                   |   |    |   | First Named Inventor   | TZANNES, MARCOS C. |
|                                                                                                   |   |    |   | Art Unit               | 2186               |
|                                                                                                   |   |    |   | Examiner Name          |                    |
| Sheet                                                                                             | 2 | of | 2 | Attorney Docket Number | T3653-9285US01     |

**OTHER PRIOR ART – NON PATENT LITERATURE DOCUMENTS**

[illegible]

|                       |  |                    |  |
|-----------------------|--|--------------------|--|
| Examiner<br>Signature |  | Date<br>Considered |  |
|-----------------------|--|--------------------|--|

<sup>1</sup> Unique citation designation number. <sup>2</sup> See attached Kinds of U.S. Patent Documents. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard St.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard St. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached. This collection of information is required by 37 CFR 1.97 and 1.98. This information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
31 July 2003 (31.07.2003)

PCT

(10) International Publication Number  
WO 03/063060 A2

(51) International Patent Classification<sup>7</sup>: G06K  
(21) International Application Number: PCT/US03/02154  
(22) International Filing Date: 24 January 2003 (24.01.2003)  
(25) Filing Language: English  
(26) Publication Language: English

(30) Priority Data:  
60/350,253 24 January 2002 (24.01.2002) US

(71) Applicant: BROADCOM CORPORATION [US/US];  
16215 Alton Parkway, Irvine, CA 92618 (US).

(72) Inventors: EFLAND, Gregory, H.; 2225 Ramona Street,  
Palo Alto, CA 94301 (US). LIANG, Haixiang; 1403  
Pitman Avenue, Palo Alto, CA 94310 (US). PETERSON,  
Kevin, H.; 725 Leona Lane, Mountain View, CA 94040  
(US). CHEN, Yuanjie; 5215 Nice Court, San Jose, CA  
95138 (US). CORRY, Alan, G.; 900 Pepper Tree Lane,  
# 621, Santa Clara, CA 95051 (US). FERRARIO, Nino,  
P.; 718 Old San Francisco Road, Apartment # 329, Sun-  
nyvale, CA 94086 (US). GUAN, Jeff, Z.; 908 Bentley

Oaks Court, San Ramon, CA 94583 (US). PRAHLAD,  
Meera; 19523 Dorchester Drive, Saratoga, CA 95070  
(US). STOMAKHIN, Ilya; 10330 Imperial Avenue,  
Cupertino, CA 95014 (US). WAN, Yongbing; 4231 Ruby  
Avenue, San Jose, CA 95135 (US). YAMANO, Larry,  
C.; 838 Gary Avenue, Sunnyvale, CA 94086 (US). YIN,  
Lin; 41741 Vaquero Court, Fremont, CA 94539 (US).  
YU, Gong-San; 325 Tramway Drive, Milpitas, CA 95035  
(US). PAPANICOLAOU, George, A.; 342 Lawson Road,  
Scarborough, Ontario M1C 2J9 (CA).

(74) Agents: SOKOHL, Robert et al.; Sterne, Kessler, Gold-  
stein & Fox P.L.L.C., Suite 600, 1100 New York Avenue,  
N.W., Washington, D.C. 20005-3934 (US).

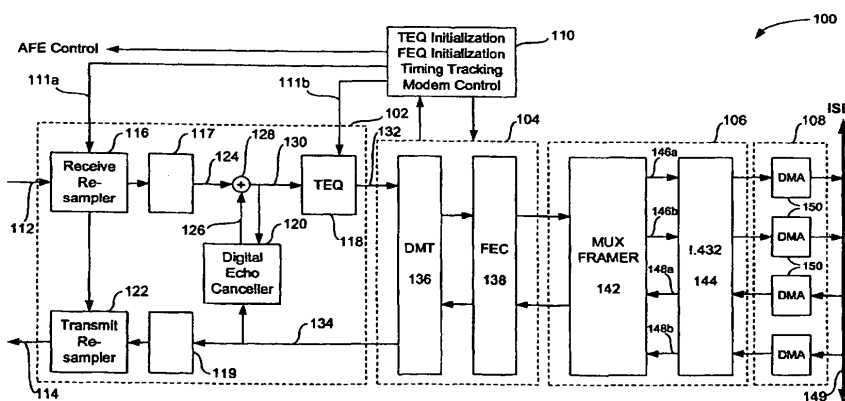
(84) Designated States (regional): European patent (AT, BE,  
BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU,  
IE, IT, LU, MC, NL, PT, SE, SI, SK, TR).

Published:

— without international search report and to be republished  
upon receipt of that report

For two-letter codes and other abbreviations, refer to the "Guid-  
ance Notes on Codes and Abbreviations" appearing at the begin-  
ning of each regular issue of the PCT Gazette.

(54) Title: ASYMMETRIC DIGITAL SUBSCRIBER LINE MODEM APPARATUS AND METHODS THEREFOR



(57) Abstract: Provided is a system and method for a modem including one or more processing paths. Also included is a number of interconnected modules sequentially arrayed along the one or more paths. Each module is configured to (i) process signals passed along the paths in accordance with the sequence and (ii) implement predetermined functions to perform the processing. Further, each of the modules has a particular degree of functional programmability and the degrees of functional programmability monotonically vary in accordance with the sequence.

BEST AVAILABLE COPY

ASYMMETRIC DIGITAL SUBSCRIBER LINE MODEM APPARATUS  
AND METHODS THEREFOR

BACKGROUND OF THE INVENTION

Field of the Invention

5           The present invention generally relates to communications, and more specifically to a highly integrated asymmetric digital subscriber line (ADSL) circuit chip for communications.

Background Art

10           An ADSL is used for data communications between a central office (CO) and customer premise equipment (CPE). At the CPE, an ADSL transceiver transmits and receives ADSL data to and from the central office. Conventional ADSL transceivers include an analog front end (AFE), a discrete multi-tone module (DMT), a forward error correction (FEC) module, a multiplexer/framer module, a protocol module, and a direct memory access  
15           (DMA) module.

BRIEF SUMMARY OF THE INVENTION

Consistent with the principles of the present invention as embodied and broadly described herein, an embodiment of the present invention includes a modem comprising one or more processing paths. Also included is a number  
20           of interconnected modules sequentially arrayed along one or more of the paths. Each module is configured to (i) process signals passed along the paths in accordance with the sequence and (ii) implement predetermined functions to perform the processing. Further, each of the modules has a particular degree of functional programmability and the degrees of functional programmability monotonically vary in accordance with the sequence.  
25           

Another embodiment of the invention includes a modem comprising a receive re-sampler associated with a receive timing scheme and a transmit re-sampler associated with a transmit timing scheme. Only one timing

- 2 -

mechanism is provided. The timing mechanism is (i) electrically coupled to the receive re-sampler and the transmit re-sampler and (ii) configured to synchronize the receive and transmit timing schemes.

5 A further embodiment of the invention includes a method for de-interleaving a data stream stored in a buffer having a plurality of memory locations, each location having a memory width of (W) bytes, the data stream being formed of a number of data words each including (N) number of data bytes, wherein (N) is a non-integer multiple of the width (W). The method comprises storing the data words into respective memory locations. The  
10 method also includes appending each of the copied data words with a number (X) of dummy bytes, a sum of (N) + (X) being an integer multiple of the width (W) and storing the appended dummy bytes into the respective memory locations.

Still another embodiment of the present invention includes a circuit  
15 comprising a fast fourier transform (FFT) address generator configured to produce a complex FFT (computation) address sequence, the complex FFT address sequence includes fixed offsets. Also included is a conversion mechanism configured to (i) receive the complex FFT address sequence and (ii) convert the received sequence into an address sequence having varying  
20 offsets.

A further embodiment of the present invention includes a method for implementing a SLICE operation in a programmable digital signal processor (DSP) as a primitive instruction in one or more data paths of a single instruction multiple data scheme (SIMD).

25 Yet another embodiment of the present inventions includes a method for sharing one or more memories between one or more processors, each memory being associated with a respective ownership flag. The method comprises associating each of the processors with a particular value of the flag and assigning use of the memories to a corresponding one of the processors  
30 when the respective ownership flag is set to the particular value.

- 3 -

Further features and advantages of the present invention, as well as the structure and operation of various embodiments of the present invention, are described in detail below with reference to the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS/FIGURES

- 5           The accompanying drawings, which are incorporated in and constitute part of the specification, illustrate embodiments of the invention and, together with the general description given above and detailed description of the embodiments given below, serve to explain the principles of the present invention.
- 10           FIG. 1 is a block diagram of an exemplary ADSL modem;  
            FIG. 2 is a block diagram of an alternative view of the functional modules of the modem of FIG. 1;  
            FIG. 3 is a block diagram further expanding on the block diagram of FIG. 1;
- 15           FIG. 4 is a more detailed view of the exemplary control processor shown in FIG. 2;  
            FIG. 5 is an exemplary illustration of a decoded byte stream;  
            FIG. 6 is an illustration of an exemplary memory buffer configured to receive the data stream of FIG. 5 in accordance with an embodiment of the
- 20           present invention;  
            FIG. 7 is a table of exemplary parameters associated with the memory buffer of FIG. 6;  
            FIG. 8 is a table of exemplary address sequences associated with the memory buffer of FIG. 6 and the parameters table of FIG. 7;
- 25           FIG. 9 is an illustration of conventional processing modules associated with implementing a fast Fourier transform (FFT);  
            FIG. 10 is an illustration of conventional FFT computational butterflies configured to implement a pre-processing in the FFT of FIG. 9;
- 30           FIG. 11 is an illustration of conventional FFT computational butterflies configured to implement a post-processing in the FFT of FIG. 9;

- 4 -

FIG. 12 is a block diagram illustration of an exemplary circuit configured in accordance with an embodiment of the present invention;

FIG. 13 is an illustration of data generation associated with the circuit of FIG. 12;

5        FIG. 14 is an illustration of exemplary output address sequences produced in accordance with an embodiment of the present invention;

FIG. 15 is a block diagram illustration of a conventional data processing path of a DSP;

10       FIG. 16 is a block diagram illustration of modifications to the illustration of FIG. 15 in accordance with an embodiment of the present invention;

FIG. 17 is an illustration of an exemplary slice decoder used in the system of FIG. 16;

15       FIG. 18 is a graphical representation of an exemplary constellation grid used in an embodiment of the present invention;

FIG. 19 is an illustration of an exemplary quantizer used in the system of FIG. 16;

FIG. 20 is a table illustrating output cycles of an embodiment of the present invention;

20       FIG. 21 is block diagram of an exemplary memory sharing scheme configured in accordance with an embodiment of the present invention;

FIG. 22 is an illustration of exemplary instruction used in the memory sharing scheme depicted in FIG 21; and

25       FIG. 23 is an illustration of additional exemplary instructions used in the memory sharing scheme depicted in FIG. 21.

#### DETAILED DESCRIPTION OF THE INVENTION

The following detailed description of the accompanying drawings illustrates exemplary embodiments consistent with the present invention. Other embodiments are possible, and modifications may be made to the  
30        embodiments within the spirit and scope of the invention. Therefore, the

- 5 -

following detailed description is not meant to limit the invention. Rather, the scope of the invention is defined by the appended claims.

It would be apparent to one of skill in the art that the present invention, as described below, may be implemented in many different embodiments of hardware, software, firmware and/or the entities illustrated in the figures. Any actual software code with the specialized control hardware to implement the present invention, is not limiting of the present invention. Thus, the operation and behavior of the present invention will be described with the understanding that modifications and variations of the embodiments are possible, given the level of detail presented herein.

I. Functional programmability.

FIG. 1 is a block diagram of an exemplary ADSL modem 100. Different aspects of the present invention reside in the environment of the modem 100. The modem 100 includes a first portion 102 including fixed components (also referred to as modules), a second portion 104 including programmable modules, a third portion 106 also including programmable modules, and a data transfer portion 108.

The modem 100 also includes a control module 110 including a plurality of control modules that perform modem control, receive signal timing recovery and tracking, equalizer (TEQ and FEQ) initialization and filter initialization. The control module 110 provides control signals 111a, 111b, and 111c (collectively, signals 111) to components within the first portion 102, described below, as well as to components with the second portion 104. In a receive direction, the modem 100 receives a digitized receive signal 112 having a fixed sample rate of 4 MHz from an analog-to-digital converter (ADC) (not shown). In a transmit direction, the modem 100 provides a digitized transmit signal 114 having a fixed sample rate of 2 MHz to a digital-to-analog converter (DAC) (not shown).

The fixed portion 102 includes a receive re-sampler 116, a receive integer decimator 117, a time domain equalizer (TEQ) 118, a digital echo

- 6 -

canceler 120, an integer interpolation module 119 and a transmit re-sampler 122. In the receive direction, the receive re-sampler 116 re-samples/retimes signal 112 to produce a re-sampled/retimed signal 320 having a sample rate of twice the ADSL sample rate of 2.208 MHz. The receive integer decimator 117 is a finite impulse response (FIR) filter that downsamples the signal 320 to produce the signal 124. In other words, the receive re-sampler 116 in conjunction with the receive integer decimator 117 converts the fixed 4 MHz sample rate of the received signal 112 to the ADSL sample rate of 2.208 MHz.

A digital echo canceler 120 cancels undesired echo from the signal 124. The canceler 120 provides an echo canceling signal 126 to a subtractor 128. The subtractor 128 subtracts the echo canceling signal 126 from the signal 124, to produce a signal 130. The signal 130 is applied to the canceler 120 as an error signal, and also to the TEQ 118.

The TEQ 118 is a finite impulse response (FIR) filter having programmable filter coefficients. The TEQ 118 has a filter response/transfer function that reduces inter-symbol interference in the receive signal 112, caused by the receive channel from which the signal 112 was received. The TEQ 118 provides an equalized signal 132 to the portion 104 of the modem 100.

In a transmit direction, the portion 104 provides a transmit signal 134 to the module 119 and the digital echo canceler 120. The module 119 consists of a series cascade of finite impulse response (FIR) filters and interpolates the signal 134 by an integer factor to produce the signal 360. The transmit re-sampler 122 re-samples/re-times signal 360 to produce the re-sampled/retimed transmit signal 114. The transmit re-sampler 122 up-samples the signal 360 to produce the signal 114. In other words, the transmit re-sampler 122 converts the 2.208 MHz sample rate of the received signal 360 to the DAC sample rate of 2.0 MHz.

It would be apparent to one skilled in the art that the receive re-sampler 116 output sample rate and the transmit re-sampler 122 input sample rate will be slightly different than 4.416 MHz and 2.208 MHz respectively if there is any clock error in the system.



- 7 -

The receive re-sampler 116, the TEQ 118, and the transmit re-sampler 122, each receive control information, such as filter coefficients, as well as other control signals, from the control modules of the control module 110.

5 The receive re-sampler 116, the receive integer decimator 117, the TEQ 118, the integer interpolation module 119, the echo canceler 120, and the transmit re-sampler 122 are implemented as hardware modules using "fixed gates." This means that each of the modules 116-122 performs a sequence of operations in a predetermined order that cannot be changed. Each of the modules 116-122 may be selectively enabled and disabled. However, the order of processing steps implemented by each hardware module, alone, and together with the other modules within the portion 102, will always remain the same.

15 The programmable portion 104 includes a DMT module 136 and an FEC module 138. Together, the DMT/FEC modules 136/138 are referred to as a DMT/FEC accelerator. To process signals flowing in the receive direction, the DMT module 136 includes, in series, a fast Fourier transform (FFT) module to perform FFTs, a frequency domain equalizer (FEQ) to perform frequency domain equalization, and a symbols-to-bits mapper to map symbols-to-bits. Symbol-to-bit mapping optionally includes trellis decoding.

20 To process signals flowing in the transmit direction, the DMT module 136 includes a bits-to-symbols mapper, a gain scaler, and an inverse fast Fourier transform (IFFT) module to perform IFFTs. Bit-to-symbol mapping optionally includes trellis encoding.

25 To process signals flowing in the receive direction, FEC module 138 includes a Reed-Solomon decoder. To process signals flowing in the transmit direction, the FEC 138 includes a Reed-Solomon encoder.

30 The DMT/FEC accelerator (the portion 104 of the modem 100) is programmable, and thus more flexible than the portion 102 of the modem 100. In other words, the DMT/FEC accelerator 104 has a higher degree of functional programmability than the portion 104. For example, the various functions performed by the modules within the DMT/FEC accelerator 104 may be changed and permuted over time. A control processor (not shown in

- 8 -

FIG. 1) controls the sequencing of these operations depending on the various modes in which the modem 100 may operate.

For example, as the modem 100 traverses various stages of ADSL signal training, the sequence of operations performed by the DMT/FEC accelerator 104 changes correspondingly. This may be referred to as “modality flexibility” within the DMT/FEC accelerator. In the instant embodiment, the DMT/FEC accelerator 104 is implemented as a combination of hardware and software. An implementation of both hardware and software facilitates the modality flexibility. The DMT/FEC accelerator 104 is programmed to accommodate signal training, and to implement a relatively complicated ADSL handshake that occurs, between the ADSL modem 100 and the central office modem.

Next, the portion 106 of the modem 100 includes a multiplexer/framer 142 and a protocol engine 144. In the receive direction, the multiplexer/framer 142 receives a bit stream from the FEC module 138, and demultiplexes the bit stream into two separate asynchronous transfer mode (ATM) receive channels 146a and 146b. The multiplexer/framer 142 provides the ATM channels 146a and 146b to the protocol engine 144. In the transmit direction, the protocol engine 144 provides two ATM transmit channels 148a and 148b to the multiplexer/framer 142. The multiplexer/framer 142 multiplexes the transmit ATM channels 148a and 148b into a transmit bit-stream 150 for the FEC 138.

The protocol engine 144 operates in accordance with an ATM standard I.432. ATM standard I.432 governs the manner in which ATM cells are constructed and Cyclic Redundancy Codes (CRCs) are computed. Thus, the protocol engine 144 verifies/validates received ATM cells, and generates transmit ATM cell information, such as CRCs, among other things.

A data transfer portion 108 is coupled between the protocol engine 144 and an internal system bus (ISB) 149. The data transfer portion 108 transfers ATM cells or bytes in and out of the modem 100. The data transfer portion 108 includes a plurality of DMA engines 150 for transferring data between the ISB 149 and the protocol engine 144, and other portions of the modem 100.

- 9 -

The portion 106 is completely in software. Thus, the portion 106 has a higher degree of functional programmability than the DMT/FEC accelerator 104, the fixed portion 102, and the data transfer portion 108. The functions associated with the portion 106 are programmable and flexible. For example, protocol engine 144 may operate in accordance with I.432 or any other suitable protocol. Alternatively, as the standard for ADSL evolves, the multiplexer/framer module may be rewritten to accommodate new framing specifications.

FIG. 2 is a block diagram of an alternative view of the functional modules of the modem 100. In the view of FIG. 2, the modem 100 includes an AFE processor 202 corresponding to the portion 102 illustrated in FIG. 1, a DMT/FEC accelerator 204 corresponding to the portion 104 in FIG. 1, a control processor 205 (not specifically depicted in FIG. 1), and a host interface (I/F) 208 corresponding to the data transfer portion 108 in FIG. 1. Also included in the view of FIG. 2 is a multiplexer 210 and a RAM 212 in which communication data and information may be stored.

As described above, the modem portions 102, 104, and 106 are implemented using progressively (monotonically) increasing degrees of programmable functionality and flexibility. The ADSL modem environment is very cost sensitive, so cost reduction is critical. The design of the modem 100 achieves cost optimization where possible, and retains flexibility where necessary. This includes reducing cost where little flexibility is needed. Less flexibility is required in the portion 102 compared to the portions 104 and 106. Thus, the portion 102 is implemented as cheaply as possible, using fixed hardware functions that have virtually zero functional programmability.

The portion 104 is more flexible and functionally programmable than the portion 102 because it is implemented as a combination of hardware and software. And, the portion 106 is even more flexible and more functionally programmable than the portion 104 because it is implemented almost entirely in software. Further aspects of the present invention, in particular the modem 100, will be described in additional detail below.

- 10 -

## II. Common Phase Accumulator.

An ADC converts a continuous time signal into a sequence of digital samples. The sampling rate is determined by the physical ADC sample clock. Conversely, a DAC converts a sequence of digital samples into a continuous time signal. The sampling rate of the digital samples is determined by the physical DAC sample clock. The underlying sampling rate of the incoming digital samples at a typical receiver (e.g., the signal 112 in FIG. 1) or the outgoing digital samples at the transmitter (e.g., the signal 114 in FIG. 1) can be altered by adjusting the physical ADC/DAC sample clocks. This approach can be expensive because it requires additional analog components. Instead, a more economical approach is to use digital resampling in the receive and transmit directions to properly re-sample/retime the receive samples from the ADC and the transmit samples sent to the DAC.

Digital re-samplers, such as the re-samplers 116 and 122 in FIG. 1, are digital filters that re-sample input signals by arbitrary rates and phase. In other words, the ratio of the input sample rate to the output sample rate need not be an exact ratio of integers. Their operation is controlled by two basic variables: phase increment and phase accumulator. The phase increment is a normalized time increment and is the ratio of the input sampling rate to the output sampling rate. The phase accumulator keeps track of the current time position (in normalized units).

In the receive direction, the combination of the ADC and the receive re-sampler 116 can effectively be viewed as an equivalent ADC whose sample rate is equal to the receive re-sampler output sample rate. Similarly, in the transmit direction, the combination of the transmit re-sampler 122 and the DAC can be viewed as an equivalent DAC whose input sample rate is equal to the transmit re-sampler input sample rate.

In an ADSL system, the ADSL transceiver unit remote terminal (ATUR) modem, derives an estimate of the ADSL transceiver unit-central office (ATUC) modem's symbol clock frequency and phase from the received signal. In the present invention, the modem 100 is the ATUR modem. The

- 11 -

symbol clock derived by the ATUR is then used for both detection of the received signal as well as transmission of the upstream signal to the ATUC. The ATUC modem uses the same clock for both transmission and reception. This process is known as loop timing.

5           Since the ATUR transmitter timing is derived from the ATUR receiver, there must be a mechanism in place to ensure that the timing of the ATUR transmitter and receiver remains locked. It is extremely desirable that the timing between the transmitter and the receiver does not drift or skew. In conventional implementations, which use two re-samplers (one in the receive  
10       path and a second in the transmit path) to produce digital samples at the desired rate, it is difficult to ensure that timing will remain locked since each re-sampler uses its own independent phase accumulator (and phase increment). The use of a single phase accumulator will ensure that the timing of the re-samplers 116 and 122 remains locked. The single phase accumulator  
15       approach is implemented in the modem 100, as is described below in connection with FIG. 3.

FIG. 3 is a block diagram that expands the illustration of the receive re-sampler 116, the transmit re-sampler 122, and the DMT 136, shown in FIG. 1. The receive re-sampler 116 includes the re-sampler 302 capable of up-  
20       sampling by a non-integer number and a re-sampler controller 306 coupled to a re-sampler coefficient generator 308. The re-sampler controller 306 includes a common phase accumulator register (i.e., phase accumulator) 309 that is shared between the receive re-sampler 116 and the transmit re-sampler 122.

Based upon inputs from the single phase accumulator 309, the re-sampler controller 306 produces re-sampler control signals 312. In response  
25       to the re-sampler control signals 312, the coefficient generator 308 provides a set of receive re-sampler coefficients 314 to the re-sampler 302. More specifically, the controller 306 uses the contents of the phase accumulator 309 to produce the correct coefficients 314 to be used for the computation of the  
30       current output sample of the interpolated signal 320.

The transmit re-sampler 122 includes a non-integer transmit re-sampler 326. In a manner similar to that described above, the re-sampler control

- 12 -

signals 312, derived from the phase accumulator 309, prompt the coefficient generator 308 to produce updated transmit re-sampler coefficients 330 and to provide the coefficients 330 to the non-integer transmit re-sampler 326. In response, the transmit re-sampler 326 computes an output sample of the interpolated signal, i.e., the digitized transmit signal 114. The controller 306 performs a fixed mapping of the contents of the phase accumulator 309, prompting the coefficient generator 308 to produce the transmit coefficients 330. Thus, the single phase accumulator 309 ensures that the timing of the re-samplers 116 and 122 remains locked.

An FFT block 340, incorporated within the DMT 136, is also depicted in FIG. 3. Based upon the interpolated signal 320, the FFT module 340 produces a signal 342 and provides the signal 342 to the timing tracking modem control portion of the module 110. The timing tracking portion of the control module 110 provides the signals 111, including control signals and updated filter coefficients, to various modules within the portion 102 (AFE processor) of the modem 100.

In more specific terms, the timing tracking portion of the module 110 provides a phase increment signal 350, a phase tweak signal 352, and an out\_bank\_coeff\_factor signal 354 to the re-sampler controller 306. These signals alter and/or act in accordance with the phase accumulator 309 and, therefore, ultimately control the phase values associated with the coefficients 314 and 330, produced by the coefficient generator 308. Thus, the single phase accumulator 309 provides mapping between the receive re-sampler 302 and the transmit re-sampler 326. This mapping provides perfect synchronized timing between the receive signal 112 and the transmit signal 114.

The modem 100 includes a receive signal timing recovery/tracking loop including the modules 302, 117, 128, 118, 310, 110, 306, 308, and 309 described above. The timing recovery loop recovers receive timing in the receive direction, and adjusts all or some of the signals 350, 352 and 354 to match the receive timing. Integral to this operation is the use of the common phase accumulator 309 for both receive and transmit re-sampling timing control. The present invention, therefore, provides a type of one-to-one

- 13 -

mapping between the receive re-sampler 116 and the transmit re-sampler 122 in order to update the common phase accumulator 309 within the timing recovery loop to achieve timing synchronization. The operation of the phase accumulator 309, in connection with control signals 111, and with reference to FIG. 3 is in greater detail below. It would be apparent to one skilled in the art that the implementation described below with some modification could be extended for other sample rates at the receive and transmit re-sampler inputs and outputs 112 320 360 114.

The following terms are defined in relation to the exemplary embodiments of FIGs. 1-3:

- phaseAcc: phase accumulator

The common phase accumulator 309 is a 32 bit register that acts as a modulo 32 bit counter. The phase accumulator 309 is updated by incrementing with the phase increment.

- phaseInc: phase increment

The phase increment 350 is 32 bit register. It represents the ratio of re-sampler 302 input sample rate to re-sampler 302 output sample rate expressed as a 32 bit integer with  $2^{29}$  representing 1.0 normalized time unit (normalized by the re-sampler 302 input sampling period); in other words, nominally phaseInc is

$$\text{phaseInc} = \text{ROUND} \left( 2^{29} \cdot \frac{4.0}{4.416} \right).$$

Before any timing information is available, the phase increment 350 is initialized with the nominal value of phaseInc given above. The phase increment is updated by the modem once the initial clock frequency error has been estimated. It would be apparent to one skilled in the art how this would be done.

- bankFactor:

The bankFactor is a 16 bit scale factor (1.15 format) used in the computation of the transmit re-sampler phase used to produce transmit re-sampler coefficients 330. The bankFactor is calculated as

- 14 -

$$\text{bankFactor} = \text{ROUND}\left(2^{15} \cdot \frac{1}{2 \cdot \phi}\right)$$

where  $\phi$  is the ratio of re-sampler 302 input sample rate to re-sampler 302 output sample rate.

5

- receive re-sampler 302 control variables

bit29[n]: (phaseAcc[31:0] & 0x20000000) >> 29 (for  
current phaseAcc)  
10 bit29[n-1]: (phaseAcc[31:0] & 0x20000000) >> 29 (for  
previous phaseAcc)

15

These variables are used to detect the crossing of a 4.0 MHz boundary indicating a new input sample from the ADC must be pushed onto the re-sampler 302 delay line.

- transmit re-sampler 122 control variables

20 bit30[n]: (phaseAcc[31:0] & 0x40000000) >> 30 (for  
current phaseAcc)  
bit30[n-1]: (phaseAcc[31:0] & 0x40000000) >> 30 (for  
previous phaseAcc)

25

30

These variables are used to detect the crossing of a 2.0 MHz boundary indicating that a new output sample must be computed by the transmit re-sampler 122. The transmit re-sampler 122 processes the phaseAcc every second phase increment (ie., for every other value of the phaseAcc) and thus the meaning of current and previous in the above definitions should be understood in this context

35

- constants

nPhaseBits: 4  
nInterpBits: 8 /\* used in linear interpolation \*/  
phaseShift: (29 - nPhaseBits) = 25  
nCcoeffs: 10 /\* number of coefficients per phase \*/

40

45

The coefficients 314 and 330 are derived from the same set of fixed coefficients as will be explained later. The fixed coefficients are extracted from a prototype filter and stored as 16 phases or banks (bank 0, 1, ..., 15) with each bank containing 10 coefficients. One additional bank, bank 16, is



- 15 -

also stored and is obtained from bank 0 by a circular shift of one sample. It would be apparent to one skilled in the art how bank 16 is generated. It would also be apparent to one skilled in the art that there are many different methods of generating coefficients 314 and 330.

- constraints

constraint:  $\text{phaseInc}[31:0] < 2^{29}$

This constraint prevents the crossing of 2 successive 4.0 MHz boundaries with a single increment of the phase accumulator; i.e., this constraint ensures that the phaseAcc can not wrap twice mod  $2^{29}$  with a single increment of the phase accumulator.

The receive re-sampler 116 computes  $\text{bit29}[n]$  for every value of phaseAcc. A wrap mod  $2^{29}$  has occurred if the XOR of  $\text{bit29}[n]$  and  $\text{bit29}[n-1]$  is 1. This wrap signifies that a new input sample must be shifted into the re-sampler 302 delay line before the current output sample can be computed. The receive re-sampler 116 computes an output sample for every value of phaseAcc. The coefficients used to compute the output sample are obtained via linear interpolation as:

```

rcvPhase[3:0] = (phaseAcc[31:0] & 0x1fffffff) >> phaseShift
c0Ptr         = coeffPtr + (rcvPhase[3:0] * nCoeffs)
alpha[7:0]    = (phaseAcc[31:0] & 0x01fe0000) >> (phaseShift -
nInterpBits)
c1Ptr         = c0Ptr + nCoeffs
coeffs[k]     = c0Ptr + ((c1Ptr[k] - c0Ptr[k]) * alpha[7:0]) >>
nInterpBits

```

NOTE:

coeffPtr is a pointer to the fixed set of 17 banks of coefficients.

The transmit re-sampler 122 operates in a similar fashion. The transmit re-sampler 122 computes  $\text{bit30}[n]$  for every other value of phaseAcc. A wrap mod  $2^{30}$  has occurred if the XOR of  $\text{bit30}[n]$  and  $\text{bit30}[n-1]$  is 1. This signifies that a new output sample must be computed. The coefficients used to compute the output sample are obtained via linear interpolation as:

- 16 -

```

    tmp                = 0x20000000 - ((phaseAcc[31:0] & 0x3fffffff)
>> 15) * bankFactor
    tmp                = MAX([0, tmp])
    xmtPhaseTmp[4:0]   = tmp >> phaseShift
    xmtPhase[3:0]      = LIMIT(xmtPhaseTmp[4:0], 0, 15)
    alphaTmp[31:0]     = tmp - (xmtPhase[3:0] << phaseShift)
    alpha[8:0]         = alphaTmp >> (phaseShift - nInterpBits)
    c0Ptr              = coeffPtr + (xmtPhase[3:0] * nCoeffs)
    c1Ptr              = c0Ptr + nCoeffs
    coeffs[k]          = c0Ptr + ((c1Ptr[k] - c0Ptr[k]) * alpha[8:0]) >>
nInterpBits

```

NOTE:  
coeffPtr is a pointer to the fixed set of 17 banks of coefficients.

The phaseInc and bankFactor parameters should be updated atomically in order to ensure that there are no glitches in the xmtPhase computation. A new input sample is shifted into transmit re-sampler 122 delay line with every other increment of the phase accumulator 309.

The ATUR receiver continuously extracts timing information from the received signal and updates the control signals 350 352 and 354 in order to track any clock drift that may occur in the system.

There are several different ways to update the timing of the re-samplers: 1) through use of a phase tweak (periodically adjust the phase accumulator), 2) through update of the phase increment, or 3) using a combination of 1) and 2). In the former case, the phase tweak is applied in conjunction with the phase increment when incrementing the phase accumulator 309. If  $\Delta$  represents the adjustment to be applied to the phase accumulator 309, it is performed by using a phase tweak given by

$$\text{phaseTweak}[31:0] = \text{phaseInc}[31:0] + \frac{\Delta}{2}$$

for 2 consecutive phase increments (the phase tweak acts as the phase increment for 2 consecutive phase increments). The phase tweak must be limited to be less than  $2^{29}$  otherwise it would be possible to wrap twice modulo  $2^{29}$  with a single increment of the phase accumulator 309. The use of

- 17 -

the common phase accumulator 309 shared between the receive re-sampler 116 and transmit re-sampler 122 ensures that receive and transmit timing is locked.

5        III.    Copying DMA With Two Separate Strides Selected by a Modulo-n Counter to Perform Convolutional De-interleaving.

10        In a communication system employing convolutional interleaving (such as an ADSL), it is necessary for the receiver to de-interleave the decoded data stream. A data buffer is used to implement the de-interleaving process. For each codeword-sized interleaved data block decoded and written  
15        into the data buffer, a single de-interleaved codeword is read from the data buffer. Because the data buffer requires substantial storage capacity, up to 16 KB for an ADSL system, it is desirable to share a single physical memory between the de-interleaving data buffer, other receiver system I/O buffers, and program and data storage. This type of shared memory architecture is known  
20        as a unified memory architecture (UMA).

25        The problem, however, with using traditional UMAs is that the codeword-sized blocks written to the de-interleaving data buffer are not an integer multiple of the width of the shared physical memory. This complicates the write interface to the shared memory by requiring it to perform alignment of the codeword-sized block and partial word writes in order to append the block to the existing data buffer contents. The second stride is also adjusted to account for a dummy byte added at the input to the interleaver (to make the interleaved block size relatively prime to the interleave depth) but not transmitted, as in systems like ADSL. The write interface is further  
30        complicated by the need to re-insert a dummy byte added at the input to the interleaver (to make the interleaved block size relatively prime to the interleave depth) but not transmitted. As a solution, the present invention uses a DMA scheme with two separate strides to copy codewords from the de-interleaving data buffer..

- 18 -

FIG. 4 is an illustration of a more detailed block diagram of the control processor 205, shown in FIG. 2. The control processor 205 is an example of a control processor, or DPS, suitable for implementing the DMA scheme of the present invention. In FIG. 4, the control processor 205 includes a central processing unit (CPU) 400, a memory 402, and an input/output interface 403. The DMA engine 404, responsible for implementing the DMA functions, includes a DMA memory storage area 406.

The DMA storage area 406 includes an exemplary de-interleaving data buffer 408, along with other DMA related storage locations. The DMA scheme is implemented using a DMA engine 404 to execute the overall DMA operations associated with the control processor 205. Thus, the DMA engine 404 receives data, via the control processor 205, based upon a received signal, such as the digitized signal 112. The received data is then placed into the data buffer 408 for de-interleaving. The data is read from the data buffer 408, or de-interleaved, in accordance with the DMA engine 404, selected DMA parameters (discussed in greater detail below), and a modulo counting scheme. The modulo counting scheme is accomplished using an exemplary modulo counter 410.

In the present invention, the use of two separate strides, for placing the data into the data buffer 408 allows the codeword-sized blocks, written to the buffer, to be appended with dummy bytes. This padding enables the codeword sized blocks to be translated to a size, or format, that is an integer multiple of the shared physical memory width. The size conversion simplifies the write interface by eliminating the need for data alignment and partial word writes into the shared memory.

The first stride specifies the increment between codeword elements necessary to perform the basic de-interleaving operation. The second stride allows the DMA engine 404 to skip over the dummy padding every codeword-size bytes. The wrapping of a modulo-n counter indicates when the second stride should be used to perform the skip.

FIG. 5 is an illustration of an exemplary decoded serial byte stream 500, segmented into codeword-sized data blocks A-G. The byte stream 500

- 19 -

includes a plurality of individual interleaved bytes, as shown, and is representative of a typical byte stream received as an input to the CPU 400 and processed by the DMA engine 404. Such byte streams are normally interleaved on the transmitter side in order to provide features such as robustness and security and thus require de-interleaving at the receiver side.

In the example of FIG. 5, and for purposes of illustration only, the byte stream 500 has a de-interleave depth (D) of "4" and a block size value (N) of "5." The de-interleave depth (D) controls the amount of time each byte is delayed. The block size value (N) specifies the number of bytes in each codeword. Thus, in the example of the byte stream 500, each of the individual bytes is delayed by four time slots. In the present invention, the DMA engine 404 is configured to efficiently place the originally transmitted bytes of the data stream 500 back into their original order (1, 2, 3, 4, 5, 6...) instead of the interleaved order (0, -, -, -, 1, 5, etc.), illustrated in FIG. 5. FIG. 6 illustrates the first step in the process of re-ordering the bytes of the data stream 500, i.e., copying each of the codeword-size blocks A-G into the data buffer 408.

In FIG. 6 the input buffer 408, shown vertically arrayed, is partitioned into separate memory locations 600 – 608. For purposes of illustration, the memory locations 600-608 correspond to the exemplary data blocks A-E. In the example of FIG. 6, each of the memory locations 600-608 has a memory width (W) of four bytes. The DMA engine 404 must respectively copy the codeword-size data blocks A-E into the memory locations 600-608. In a first stage of de-interleaving the byte stream 500, the DMA engine 404 writes the first block A, is indexed 0, -, -, -, 1, into the memory location 600 in the manner illustrated in FIG. 6.

A common requirement on many different types of memories is that data must be written to the memory in integer multiples of the memory width (W). Although exceptions to this requirement are possible, the exceptions provide inefficient, overly complex schemes that sacrifice speed and power and erode other valuable system resources. Therefore, in the present invention, the DMA engine 404 will copy the five bytes of the data block A,

- 20 -

and all of the other five byte codeword-size blocks B-G, into the buffer 408 in multiples of four bytes at a time.

Since the data blocks A-E are five bytes in width, and thus not a multiple of the memory width (W) of four bytes, the data blocks A-G must be appended, or padded, with three dummy padding bytes 610-618 respectively. This padding artificially converts the length of each of the blocks A-E to eight bytes, a multiple of the memory width (W) four. With all of the exemplary data blocks A-E, including the appended padding bytes 610-618, now having been stored in the respective memory locations 600-608, the DMA engine 404 must now perform the de-interleaving.

FIG. 7 is an illustration of essential parameters used by the DMA engine 404 to de-interleave the now padded data blocks A-E, stored in the memory locations 600-608 of the buffer 408. The DMA parameters shown in FIG. 7 are typically stored in DMA registers or storage areas, such as the DMA memory storage area 406. As noted above with reference to FIGs. 5 and 6, the byte stream 500 and the DMA parameters of FIG. 7 are for the exemplary case where the interleave depth (D) is 4 and the byte size (N) is 5. traditional DMA engines use many other DMA parameters to perform de-interleaving. The present invention also uses some of these other DMA parameters. For purposes of clarity, however, the present application will not address these other parameters since their use remains unchanged in the present invention. Instead, the description of the present invention will focus on the DMA parameters shown in FIG. 7.

The STRIDE is the first of the DMA parameters listed in FIG. 7, and is has a value of 4. In the present invention, the STRIDE is the distance from one byte, that requires copying to memory, to the next byte requiring copying. STRIDE2, with a value of 4+3, is similar to the STRIDE, plus the number of padding bytes, such as the three bytes of padding 610 stored in the memory location 600. Thus, in the case of STRIDE 2, the DMA engine will skip over the padding bytes 610 in addition to the interleave depth. The number of padding bytes is referred to as the PADSIZ.

- 21 -

In the example of FIGs. 6 and 7, the STRIDE increments through all of the values of the block A (0, -, -, and 1) to obtain the value "1." And the "3" in the STRIDE2 implies skipping over the "5" and the two dashes that follow the "5" of the block B, to get to the "2" value of the block B. Also included in the DMA parameters are the values of OFFSET, OFFSET INC, and OFFSET MOD, discussed in greater detail below.

The following is an exemplary approach to initializing the DMA parameters shown in FIG. 7 of the instant invention:

```

10      stride      = floor(D / N) * (N + PADSIZ) + (D mod N)
      stride2     = stride + PADSIZ
      offset      = 0
      offsetInc   = D mod N
      offsetMod   = N

```

15 where D is interleave depth  
       N is interleave length (i.e. including any pre-interleave padding)  
       PADSIZ is number of padding bytes per codeword (including any pre-interleave padding not transmitted which is negative)

20 The DMA computes each address to copy from as follows:

```

      offset += offsetInc
      if (offset >= offsetMod) then
25          offset -= offsetMod
          address += stride2
      else
          address += stride

```

30 FIG. 8 is an illustration of an exemplary DMA address sequence for determining the order in which the de-interleaved data bytes of the blocks A-E are read from the buffer 408. In FIG. 8, step 0 represents the reading of address A, which is the beginning of the buffer 408, where the bytes are numbered from left to right. Thus, the DMA engine 404 will first read the value "0" at address A. Address A corresponds to the first byte of the first row of the memory location 600 of the buffer 408. Next, in step 1, the DMA engine 404 will increment the address by the STRIDE value of "4." Thus, address A+4 of the buffer 408 will be read, which contains the value "1." The

- 22 -

address A+4 corresponds to the first byte of the second row of the memory location 600.

5 In step 2 of FIG. 8, the STRIDE2 of FIG. 7 will be used instead of the STRIDE, which represents an increment of 7. Thus, the DMA engine 404 will skip over 7 values to obtain the value of "2," shown in byte position four of the memory location 602. The DMA engine 404 will continue to read the remaining contents of the memory locations 602-608 to finally produce a de-interleaved byte stream sequenced as 0,1,2,3,4,5....

10 In any particular read cycle, the DMA engine 404 will use STRIDE or STRIDE2, but not both at the same time. Thus, the DMA engine 404 must know apriorily whether to use STRIDE or STRIDE2. The values of the OFFSET column of FIG. 8 determine whether the DMA engine 404 will use STRIDE or STRIDE2. The values of the OFFSET column operate based upon a modulo-n counting scheme. The modulo-n counting scheme controls the  
15 OFFSET, OFFSET INC, and OFFSET MOD (the modulo of how the offset of FIG. 8 is incremented) of the DMA parameters shown in FIG. 7.

The offset of FIG. 8 initially begins at 0, and for each step, is incremented by the OFFSET INC value. If the offset is initially 0, it will ordinarily be incremented by 4 each time. However, the offset counts by  
20 modulo. Therefore, in the example of FIGs. 5 -8, the only legal numerical values are 0-4, since the present example is based on modulo-5. The OFFSET MOD value corresponds to the byte size (N). Thus, in FIG. 8 at step 0, the offset is 0, and then the DMA engine 404 increments by 4. In step 1, the offset is 4. In step 2, the DMA engine 404 increments by 4 again, and so it  
25 would ordinarily be 8. The value, however, gets reduced because the counting is based on modulo-5, which in-turn, produces the offset value of 3. The remaining values of the offset column of FIG. 8 are determined in this manner and this process continues until the entire byte stream 500 is completely de-interleaved.

30 Thus, in accordance with the present invention, the DMA engine 404 uses two strides to facilitate an efficient implementation of a UMA memory technique. This technique ensures that codeword-size data blocks can be



- 23 -

written into memories in cases where the originally transmitted data blocks are not an integer multiple of the width (W) of the input buffer memory. In so doing, this process eliminates the need to perform alignment and partial word writes of the data blocks, which provides significant savings of system resources.

IV. Conditional One's-complement of Partial Address to Map Butterfly Address Generation to FFT/IFFT Post-/Preprocessing Pass Address Generation.

Processors, such as the control processor 205 of FIG. 2, support FFT/IFFT functions through use of standard radix-2 butterfly operations. These butterfly operations are specific implementations of an FFT algorithm in cases where the number of input samples is a power of 2. In order to implement these FFT/IFFT functions, the processor 205 includes address generation logic to access the input and output operand pairs (address pairs) of each butterfly.

One way of generating the butterfly input and output address pairs is to use a pointer and a fixed offset to access the operands at addresses 'pointer' and 'pointer+offset', incrementing the pointer through each recursion in the FFT/IFFT stage. A preferred approach would be to support optimized implementations of the FFT/IFFT for real-valued FFT inputs and IFFT outputs using standard post and pre-processing steps. Using standard post and pre-processing steps, however, the inputs to the butterfly operations of the post-and pre-processing steps are not separated by a fixed offset, and thus cannot use the normal operand addressing logic.

As a solution, the present invention uses an exemplary circuit implementation to conditionally invert the  $n-1$  least-significant bits (LSBs) of the butterfly operand addresses provided for an  $N$ -point FFT/IFFT, where  $N = 2^n$ . The  $n-1$  LSBs are inverted when the  $n$ 'th operand address bit (address[ $n-1$ ] where the LSB is address[0]) is 1, otherwise the LSBs are unchanged. This effectively reverses the last  $N/2$  inputs to the real-valued FFT post-processing

- 24 -

pass or IFFT pre-processing pass, yielding un-unfixed offset between the inputs to the butterfly operations of the pass.

FIG. 9 is an illustration of a conventional 512 point FFT implementation 900. In FIG. 9, pairs of 512 real-valued inputs 902 are represented in the form of a 256 point (pre-processing) complex FFT 904. Using a traditional FFT approach, the 256 point complex FFT values are processed in the stage 904. Next, a conventional FFT post-processing stage 906 is implemented to produce 256 complex outputs 908. FIGs. 10 and 11 provide more detailed illustrations of the complex FFT operation 904 and the FFT post-processing stage 906.

In FIG. 10, a complex FFT operation, such as the pre-processing FFT operation 904, is implemented using a standard radix-2 butterfly 1000. A butterfly is a computational technique that takes a pair of real-valued FFT inputs and produces a pair of complex outputs. While the FFT operation 904 of FIG. 9 is a 256 point FFT, for purposes of simplification, the butterfly technique 1000 is demonstrated using an 8 point FFT.

In the illustration of FIG. 10, 8 complex value inputs 1002 (representative of 16 real-valued inputs) are provided as inputs to the butterfly 910. Outputs 1004 of the butterfly 1000 are represented as output addresses B0-B3. The output address B0 is associated with complex value inputs 0 and 4, which are provided as inputs to a first butterfly calculation (of the butterfly 1000). The output address B1 is associated with inputs 1 and 5, which were provided as inputs to a second butterfly calculation, the address B2 is associated with inputs 2 and 6, and so on, as illustrated in the step/address table 1006, also shown in FIG. 10. A point of interest with regard to the output addresses B0-B3, is that distances 1008-1012 (or offsets) between the addresses B0-B3 are fixed, with respect to each of the butterfly calculations of the butterfly 1000.

In FIG. 11, a standard post-processing operation, such as the post-processing operation 906, is implemented using a butterfly 1100. The butterfly 1100 receives inputs pairs 1102 and produces outputs 1104, shown as addresses C0-C2. In the post-processing butterfly 1100, however, offsets

- 25 -

1106-1110, associated with the inputs 1102, are not fixed. That is, the offsets 1106-1110 decrease in length for each of the butterfly calculations associated with the butterfly 1100. In an exemplary embodiment of the present invention, FFT pre-processing output addresses having fixed offsets, such as the exemplary addresses B0-B3, are transformed into FFT post-processing addresses having decreasing offsets, such as the exemplary addresses C0-C2.

FIG. 12 is a block diagram illustration of an exemplary circuit 1200 be configurable to transform the addresses output from an FFT pre-processing stage into addresses representative of an FFT post-processing stage. The circuit 1200 can be inserted into the logic path of a DSP controller, such as the controller 205 of FIG. 2, to perform this address transformation.

The circuit 1200 is coupled to an output of a conventional FFT address generator 1201. The address generator 1201 is included as part of an FFT intermediate processing FFT algorithm, such as the operation 904, and produces FFT complex values, such as those that would be provided to the post-processing operation 906. At a high level, the circuit 1200 is configured to perform a conditional one's complement of the address output from the address generator 1201.

The circuit 1200 includes a mask generator 1204 and a logic gate 1206 configured to perform a complementing operation. In the embodiment of FIG. 12, the logic gate is an exclusive OR gate, although other suitable logic circuits can be used. A value (n) specifies the number of address lines or bits output from the FFT address generator 1201. Another value (N) represents the size of the FFT operation to be performed, such as 256 point or 512 points, and is provided as an input to the mask generator 1204.

The mask generator 1204 allows the circuit 1200 to function with FFTs of different sizes. The mask generator 1204 also determines how many of the bits, output from the address generator 1201, should be complemented. A pre/post processing enabling signal 1208 is provided as input to the mask generator 1204. The signal 1208 enables the circuit 1200 when an FFT computation reaches the post-processing stage 906. The function of the circuit 1200 is explained in greater detail below, in relation to FIG. 13.

- 26 -

FIG. 13 is a detailed illustration of exemplary outputs 1300 of the FFT generator 1201. FIG. 13 also illustrates exemplary masks 1302. Each row of the masks 1302 is associated with a corresponding one of the rows of the outputs 1300, as indicated by the arrows. As noted above, the value (N) specifies the size of the FFT operation to be implemented. The example of FIG. 10, where (N) is 8, corresponds to the first two rows of the outputs 1300. An (N) value of 16 corresponds to the third and fourth rows of the addresses 1300 and masks 1302. In the example where (N) is 8, there is only one bit of the FFT generator 1201 that will control one of two output values of its corresponding mask within the mask values 1302.

When the signal 1208 indicates that the FFT post-processing is occurring, the mask generator 1204 is enabled. The output of the mask generator 1204 is then exclusively OR'd with the addresses having fixed offsets, output from the address generator 1201. The output of the circuit 1200 is a conditionally inverted address sequence having decreasing outputs, as discussed above. FIG. 14 is a more detailed illustration of the output of the circuit 1200.

In FIG. 14, steps 2-255 are shown, each corresponding to one of the addresses within an address sequence 1402. The address sequence 1402 is provided as an output from the address generator 1201 and includes fixed offsets (1/128, 2/129, 3/130, etc.). The circuit 1200, however, transforms the address sequence 1402, as described above, into the address sequence 1404 having decreasing offsets (1/255, 2/254, 3/254, etc.).

The present invention, therefore, provides significant economies by enabling the calculation of the post-processing FFT address sequence directly from the output of the FFT address generator 1201. This calculation is achieved through the use of simple logic circuit that performs a one's complement of the fixed offset addresses and a mask of the address. Thus, the techniques of the present invention facilitate savings of significant hardware resources that would ordinarily be dedicated to performing FFT post processing address.

- 27 -

V. Definition and Implementation of SLICE Instructions on a Programmable SIMD Processor Data Path.

An important function in digital communication receivers is the 'slicing' of a received data symbol to determine the nearest point (or phase state) on a constellation grid. That is, the digital communication receivers must be able to closet grid point, from a standpoint of distance, that a particular received symbol value is associated with when it was transmitted. Put more simply, the receiver use slicing to determine precisely what was originally transmitted.

One commonly used approach to perform slicing in a DSP is through execution of a sequence of conventional instructions. The slicing function can also be implemented in dedicated logic, but this approach is inflexible and requires additional hardware resources. Dedicated logic, however, is unnecessary in systems where data paths of a SIMD based programmable DSP, such as the controller 205 of FIG. 2, can be modified to perform the slicing functions.

The instant invention provides an approach for slicing operations to be more efficiently and upported directly on a programmable DSP. This more efficient approach is facilitated through extensions to the instruction set, modifications to internal data paths, and use of control logic. The slicing operations are implemented using the data path logic that is provided for other basic operations.

DSPs typically provide functional units for multiplication, addition (accumulation) and result scaling. Many DSPs provide multiple sets of such units, controlled with a SIMD scheme to enhance performance. Slicing can be efficiently implemented using pairs of such units processing the in-phase and quadrature phase (I and Q) components of a received symbol. A more detailed discussion of preferred embodiments of the present invention is provided below in relation to a description of FIGs. 15-20.

FIG. 15 is a block diagram illustration of a conventional three stage DSP functional SIMD based data module 1500, having first and second

- 28 -

parallel paths 1502 and 1504. Since the first and second data paths 1502 and 1504 include identical functional modules, the discussion of the first parallel path 1502 will apply equally to the parallel path 1504. The conventional data module 1500 includes a first pipeline stage 1506 including a multiplier 1507, a  
5 second pipeline stage 1508 including an adder 1509, and a third stage 1510 including a scalar 1511. Also included are registers 1512 for holding addresses or instructions used for manipulation of data passed through each of the stages of the data module 1500.

In the conventional functional data module 1500 illustrated in FIG. 15,  
10 input operands OP1n and OP2n are received, from general registers, as inputs to the stage 1506 of the first path 1502 during a current timing cycle. The input operand OP1n might, for example, be representative of the "I" component of a received data point in the exemplary form of a 16 bit data word. The operand OP2n is traditionally representative of a scaling factor.  
15 The operands OP1n and OP2n are multiplied together in the multiplier 1507.

Next, the product of the multiplier 1507 is provided to the input of the adder 1509 in accordance with, for example, instructions stored in one of the registers 1512. In the module 1500, the second data path 1504 is configured to receive symbol data associated with the symbol's "Q" component, as  
20 discussed above. Further, while the first stage 1506 process the input from the current timing cycle, the stage 1508 is simultaneously processing an input from a previous timing cycle and the stage 1510 is simultaneously processing an input from an even earlier timing cycle.

A rounding value, provided as an input to a mutiplexer 1514, is added  
25 to the first product of the multiplier 1507 during the noted timing cycle. For subsequent products output from the multiplier 1507, the multiplexer 1514 selects its lower path such that the products are added with previous sums. A rounding value is provided so that when scaling is performed in the third stage 1510, the scaling will be performed on a sum having a fixed number of data  
30 bits.

Next, the result from the adder 1509 is scaled in the third stage 1510 by a scalar 1511. The scalar 1511 multiplies the result, output from the adder

- 29 -

1509, times  $2^{(-k)}$ , where (k) is specified by the DSP instructions. The output of the scalar 1511, labeled as RSLTn, is then provided as an overall output of the data module 1500. As previously noted, FIG. 15 is an illustration of a conventional SIMD processor data path. FIG. 16, however, is an illustration of modifications, in accordance with the present invention, to the conventional data path of FIG. 15. This modification enables the data path to more efficiently support symbol slicing instructions.

In general terms, FIG. 16 provides a block diagram illustration of an exemplary data path module 1600 capable of performing symbol slicing instructions as part of its instruction set, i.e., performing the slice instruction as a primitive instruction. An advantage of the approach of the present invention is a reduction in the number of input cycles required to execute slice instructions. In a conventional DSP, slice instructions can require 20 or more cycles for execution. In the exemplary embodiment of FIG. 16, however, slice instructions can be executed within about two cycles.

More specifically, FIG. 16 includes a data path module 1600 including conventional components, such as the multiplier 1507, the adder 1509, and the scalar 1511, shown in FIG. 15. The module 1600, however, also includes an additional operand path 1602 and an additional multiplexer 1604.

A constants generator 1606 is provided to scale the bit stream associated with OP1 (the I or Q component) into a format that has its binary point in a fixed position. The scaling directly supports the slicing function and scales each of the I and Q components to a fixed format by multiplying OP1 by  $2^{(k-b)}$ , where k is a constant chosen based on the data path precision and b, an instruction parameter or operand, indicates the number of fractional bits in, for example, the 16 bit data stream of the I or Q component.

When control logic of the DSP detects that the data module 1600 is executing a slicing instruction instead of standard DSP instructions, the multiplexer 1604 selects its operand path 1602 (lower path). When the path 1602 is selected, OP1 is received and is multiplied by the expression  $2^{(k-b)}$  and is thus scaled into the fixed binary point format. The use of a fixed format simplifies subsequent processing.

- 30 -

Next, OP1n and the fixed format value (output from the constants generator 1606) are multiplied together in the multiplier 1507. The product of the multiplier 1507 is provided as an input to another multiplexer 1608. Also provided as an input to the multiplexer, are boundary constraints 1610 which are output from a slice decoder 1700, illustrated in FIG. 17. The slice decoder 1700 and the boundary constraints 1610 are discussed in greater detail below and in relation to FIG. 17.

FIG. 17 is an illustration of an exemplary slice decoder 1700. The slice decoder 1700 is conventional logic that is configured to receive the sign bits of the I and I components associated with the received symbol data. The decoder 1700 also receives data representative of the particular constellation grid associated with the transmitted symbol data. The output of the decoder 1700 is a set of I and Q limit values 1610 (boundary constraints) and a set of I and Q load enable conditions 1702. The limit values 1610 and the enable conditions 1702 are a function of the location of the received symbol on a particular constellation grid, such as the grid shown in FIG. 18.

FIG. 18 is a graph of a conventional 4 x 4 constellation grid 1800. Constellation grids are representative of accepted communications standards and include two-dimensional displays of the baseband I and Q values of transmitted and received data symbols, as measured at a particular point in time. A vector from the center of the diagram to a specific constellation point is representative of the amplitude of the symbol. When symbol data is originally transmitted, its I and Q components have specific coordinates within a constellation grid. Due to noise, transmission error, and other factors, the symbol's receive constellation grid values often differ from its transmission constellation grid values. As noted above, the present invention is an efficient technique to determine the original transmitted constellation grid values of the originally transmitted data symbol.

Although the constellation grid of FIG. 18 is a 4 x 4 representation, the present invention can operate with constellation grids of other sizes, such as 2 x 2, 8 x 8, or diagrams that are not square. In FIG. 18, the points "A" and "B" are representative of the I and Q components of bits that combine to form a



- 31 -

transmitted data symbol. When the points "A" and "B" were originally transmitted, they were associated with specific coordinates, or points, on the grid 1800. During transmission, however, the points moved off of their original grid coordinates as shown.

5           Therefore, the DSP, using instructions within the data module 1600, must slice the received symbol data to determine which of the coordinates on the grid that the points "A" and "B" were originally transmitted on. With reference to FIG. 17, the limit values 1610 are representative of the limits of the I and Q axis of the grid. In the exemplary grid 1800, the limits of the I  
10           axis are +3 and -3, and the limits of the Q axis are also +3 and -3. These limits define a ring of grid points. The I and Q conditions 1702, on the other hand, are associated with whether the "A" and "B" points are actually within the ring of points.

          Referring back to FIG. 16, the product of the multiplier 1507 is  
15           representative of an actual I or Q component of one of the A and B points. This product is received as an input to the multiplexer 1608. The multiplexer 1608 then alternately provides the product of the multiplier 1507 and the I and Q limit values 1610 to the adder 1509, which in the present invention, is used as a comparator. The output of the adder 1509 is used to determine whether  
20           the points A and B are within the ring of I and Q points (finite grid) or outside the ring of points (infinite grid). As seen in FIG. 18, A is within the ring of points and B is outside.

          The output of the adder 1509 is provided as an input to a quantizer  
25           circuit 1612. The quantizer circuit 1612 essentially forces the points A and B to the nearest point on the infinite grid. Subsequent cycles use the adders to implement boundary clamping via per-quadrant min/max operations that conditionally load the result registers (accumulators) based on comparisons performed by the adders (with possible auxillary comparisons). The constants can be read from a table indexed by an instruction operand or directly  
30           specified by the operand. Additional details of the circuit 1612 are provided in the discussion concerning FIG. 19.

- 32 -

In FIG. 19, the quantizer circuit 1612 includes an OR gate 1900 and an AND gate 1902 coupled to the OR gate 1900. A quantize signal is provided by the DSP control logic as a control signal to activate the quantizer 1612. At a more detailed level, the quantizer masks the k LSBs of the symbol data prior to storage in a results register 1614 (accumulator) to implement the quantization of each component when enabled. Also added to the results register 1614 are the I and Q conditions (load enable) 1702 from the slice decoder 1702 shown in FIG. 17. The quantized components are compared against constants determined by the constellation size and sign of the component in the accumulator register 1614. In other words, the accumulator results register 1614 compares the results of the quantizer with the actual I and Q input data symbol conditions.

The quantizer 1612 essentially forces the LSBs of the receive symbol data, to zero. The k-1 bits go through the AND gate 1902 and the next bits are received by the OR gate 1900. The most significant bits, which are left over, simply pass through the quantizer 1612 and remain unchanged. When the quantizer 1612 is in use, the adder 1509 can be used to implement symmetric rounding (about the point origin) and/or offset adjustment for constellations that aren't centered about the point origin.

Finally, an output from the results register 1614 is provided to the scalar 1511. The results scalar 1511 is used to divide each component by  $2^{(k-b)}$  to return the components to the input format. The output of the scalar 1511 is a determination of the nearest grid points to the points A and B, within the constellation grid 1800. An exemplary slicing sequence implemented by the data module 1600 will be described in relation to a description of FIG. 20.

FIG. 20 is an exemplary table 2000 representative of two input cycles of the data module 1600. In FIG. 20, data points A and B are shown along a vertical column to the left. A "cycle" column shows two input cycles of the data path module 1600 for receiving input symbol data related to data points A and B. In cycle 1, the table 2000 shows that a quantize enable signal is "set" to activate the quantizer 1612. Since the quantize signal is present, the

- 33 -

limits and conditions, included in the table 2000, are not used. Thus, the module 1600 will select the nearest grid point in infinite grid.

5       The grid 1800 illustrates that the nearest grid point in infinite grid of the I and Q coordinates, for point A, are -1 and -1. In cycle 2, the quantization has already been accomplished so the quantization signal is not set. Thus, the next comparison of the input symbol data is against the limits. Here, the I limit is -3 and a condition of "less than." The conditions of "less than" or "greater than" are a function of the quadrant that the point appeared in.

10       Similarly, for Q, the limit is -3, with a condition of "less than." Since in this case, the nearest point on infinite grid was within the actual 4 x 4 grid, the second cycle did not make any changes. Therefore, the result of the symbol slicing in this case was -1 and -1 for both the I and Q components, which correspond with a point on the grid 1800. The results for the point B, 15       however, are slightly different.

      The table 2000 illustrates that for the cycle 1, the quantize control signal is set. Therefore, the first step will be to quantize the symbol data associated with B onto the infinite grid. In this case, the output coordinates for I and Q are 1 and -5 respectively. The first arrow pointing away from point B 20       on the grid 1800, points to the coordinates 1 and -5 for I and Q respectively. During cycle 2, the point B is compared against the limit of the finite grid. This comparison illustrates that the data point B is outside of this limit. Here, therefore, the result of cycle 2 is 1 and -3 for the I and Q limits, respectively. Thus, both points A and point B have now been associated with their nearest 25       points in infinite grid, and consequently, associated with their original constellation grid coordinates.

      The present invention, therefore, provides an approach for slicing operations to be more efficiently supported directly on a programmable DSP. The approach of the invention is facilitated through extensions to the 30       instruction set, modifications to internal data paths, and use of control logic. The slicing operations are implemented using the data path logic that is provided for other basic operations. This approach facilitates performing the

- 34 -

slice instruction as a primitive instruction. An advantage of the approach of the present invention is a reduction in the input cycles required to execute a slice instruction. The present invention reduces the required cycles from 20 to 2 or 3 cycles.

5 VI. Program Synchronization of A Processor and DMA Using Ownership Flags.

A processor DSP is often paired with a DMA engine and two working memories so that processor execution on data in one memory can overlap DMA transfers to and from the other memory. Higher performance processors  
10 require more bandwidth than can be provided by a single working memory; additional bandwidth can be supplied by additional working memories. A synchronization mechanism is required to ensure that a given working memory is only in use by either the processor or the DMA at any given time, and to provide flow control of data passed between the processor and DMA  
15 engine.

FIG. 21 is a block diagram illustration of an exemplary processor/DMA memory sharing scheme 2100. In FIG. 21, the memory sharing scheme 2100 includes another exemplary DMA engine 2102, a processor 2104, memories A-D, and associated ownership flags 2106.

20 FIG. 22 is an illustration of exemplary DMA program instructions 2200 and processor program instructions 2202, used in connection with the DMA engine 2102, the processor 2104, and the memories A-D.

Finally, FIG. 23 is an illustration of management and execution of the DMA program instruction 2200 and the processor program instructions 2202  
25 based upon specific settings of the ownership flags 2106.

Systems with two or more working memories, such as the memories A-D, typically have the DMA engine 2102 and processor 2102 wait for each other upon completion of the tasks 2200 and 2202, shown in FIG. 22. When both the DMA engine 2102 and the processor 2104 have finished, the roles of  
30 the memories A-D are swapped and the DMA engine 2102 and the processor

- 35 -

2104 continue with the next set of tasks. This process is repeated for each set of tasks.

5       The ownership flags 2106 are provided to indicate, for each of the memories A-D, whether its use is controlled by the DMA engine 2102 or processor 2104. Specific instruction sets are provided for both the DMA engine 2102 and the processor 2104 for testing and setting the flags 2106. One instruction, from within the instruction set 2102, waits for the specified set of ownership flags to indicate ownership by the DMA engine 2102 or the processor 2104 executing the instruction. The other instruction sets the  
10       specified set of ownership flags 2106 to indicate ownership by the DMA engine 2102 or the processor 2104 not executing the instruction.

15       The memory sharing scheme 2100, along with software convention, allows programs running on the DMA engine 2102 and the processor 2104. The scheme 2100 avoids simultaneous use of the exemplary working memories A-D by transferring ownership of the memories, when finished with the memory, and waiting for ownership before accessing the memory. Similarly flow control is implemented by waiting for ownership of the memory containing the data being transferred before operating on it.

20       The present invention has been described above with the aid of functional building blocks illustrating the performance of specified functions and relationships thereof. The boundaries of these functional building blocks have been arbitrarily defined herein for the convenience of the description. Alternate boundaries can be defined so long as the specified functions and relationships thereof are appropriately performed.

25       Any such alternate boundaries are thus within the scope and spirit of the claimed invention. One skilled in the art will recognize that these functional building blocks can be implemented by analog and/or digital circuits, discrete components, application specific integrated circuits, firmware, processors executing appropriate software and the like or any  
30       combination thereof. Thus, the breadth and scope of the present invention should not be limited by any of the above-described exemplary embodiments,

- 36 -

but should be defined only in accordance with the following claims and their equivalents.

- 37 -

## WHAT IS CLAIMED IS:

1. A modem, comprising:  
5 one or more processing paths; and  
a number of interconnected modules sequentially arrayed along the one or more of the processing paths, each module being configured to (i) process signals passed along the paths in accordance with the sequence and (ii) implement unique functions to perform the processing;  
10 wherein each of the modules has a particular degree of functional programmability; and  
wherein the degrees of functional programmability monotonically vary in accordance with the sequence.
- 15 2. The modem of claim 1, wherein the modem is an asymmetric digital subscriber logic (ADSL) modem.
3. The modem of claim 2, wherein the one or more processing paths include a receive path and a transmit path.  
20
4. The modem of claim 3, wherein the interconnected modules includes at least one of an analog front end, a discrete multi-tone module/frequency domain equalizer and a direct memory access engine.
- 25 5. The modem of claim 1, wherein the predetermined functions include at least one of resampling, echo cancellation, fourier processing, and error correcting.
- 30 6. The modem of claim 5, wherein the functional programmability includes non-programmable hardware, programmable hardware, firmware, and software.

- 38 -

7. The modem of claim 5, wherein the variations are representative of monotonic increases.

8. A modem comprising:  
a receiver associated with a receive timing scheme;  
a transmitter associated with a transmit timing scheme; and  
only one timing mechanism (i) electrically coupled to the receiver and the transmitter and (ii) configured to synchronize the receive and transmit timing schemes.

9. The modem of claim 9, wherein the receiver includes a receive re-sampler and the transmitter includes an transmit re-sampler.

10. The modem of claim 9, wherein the modem is an asymmetric digital subscriber line (ADSL) modem.

11. The modem of claim 10, wherein the timing mechanism includes a phase accumulator.

12. The modem of claim 10, wherein the timing mechanism includes a coefficient generator and a phase accumulator.

13. A modem comprising:  
a receive re-sampler configured to receive input signals in accordance with a receive timing scheme;  
a transmit re-sampler connected, at least indirectly, to the receive re-sampler, the transmit re-sampler being configured to transmit output signals in accordance with a transmit timing scheme; and  
only one timing mechanism electrically coupled to the receive re-sampler and the transmit re-sampler;  
wherein the timing mechanism is configured to synchronize the receive timing scheme and the transmit timing scheme.



- 39 -

14. The modem of claim 13, wherein the modem is an asymmetric digital subscriber line (ADSL) modem.

5

15. The modem of claim 14, wherein the receive input signals includes digitized input signals.

10

16. The modem of claim 15, wherein the receive re-sampler produces interpolated signals based upon the received input signals and first timing coefficients.

15

17. The modem of claim 16, wherein the transmitted output signals include digitized output signals.

18. The modem of claim 16, wherein the transmitted output signals include second timing coefficients.

20

19. The modem of claim 18, wherein the first and second timing coefficients are produced based upon linear interpolation, the linear interpolation being a function of phase increment and phase accumulator.

25

20. The modem of claim 19, wherein the timing mechanism includes a phase accumulator.

21. The modem of claim 19, wherein the timing mechanism includes a phase accumulator and a coefficient generator.

30

22. The modem of claim 16, further comprising a timing tracking mechanism configured to receive the interpolated signal and produce timing data therefrom.

- 40 -

23. The modem of claim 22, wherein the phase accumulator is configured to (i) receive the timing data and (ii) update the first and second timing coefficients based upon the received timing data.

24. A method for synchronizing timing in a modem having a receiver configured to receive an input data signal and a transmitter configured to produce an output data signal, the output data signal having timing characteristics based upon a transmit coefficient signal, the method comprising:

receiving (i) the input data signal and (ii) a receive coefficient signal in the receiver;

re-sampling the input data signal based upon the received coefficient signal to produce an interpolated signal thereby;

producing signal phase data based upon the interpolated signal; and

updating the receive coefficient signal and the transmit coefficient signal based upon the signal phase data.

25. The method of claim 24, wherein the signal phase data includes a phase increment, a phase tweak, and a coefficient factor.

26. The method of claim 24, wherein the updating includes adjusting a phase of the receive coefficient signal and transmit coefficient signal.

27. A method for de-interleaving a data stream stored in a buffer having a plurality of memory locations, each location having a memory width of (W) bytes, the data stream being formed of a number of data words each including (N) number of data bytes, wherein (N) is a non-integer multiple of the width (W), the method comprising:

storing the data words into respective memory locations;

appending each of the stored data words with number (X) of dummy bytes, a sum of (N) + (X) being an integer multiple of the width (W); and

- 41 -

storing the appended dummy bytes into the respective memory locations.

5           28.    The method of claim 27, wherein the data words include codeword-size data blocks.

          29.    The method of claim 28, wherein the interleaved data stream includes an interleave depth (D); and  
                wherein the method is implemented based upon operation of a direct  
10           memory access (DMA) engine.

          30.    The method of claim 29, further comprising de-interleaving the data bytes stored in the respective memory locations based upon operation of the DMA engine and a number of parameters;  
15           wherein the parameters include first and second memory strides, an offset increment value, and an offset modulo value.

          31.    A method for storing a data stream in a modem buffer having a plurality of memory locations, each location having a memory width of (W) bytes, the data stream being formed of a number of data words each including (N) number of data bytes, wherein (N) is a non-integer multiple of the width (W), the method comprising:

                (a) copying the (N) data bytes of a first data word into a first [(n)(W)] bytes of a first location, where (n) is an integer that (i) equals one when  $W > N$  and (ii) is a smallest among all integers satisfying the expression  $[(n)(W) > N]$  when  $W < N$ ;

                (b) appending the first number (N) of copied bytes with (X) number of dummy bytes, a sum of  $(X) + (N)$  being an integer multiple of the width W; and

30               (c) copying the appended dummy bytes (X) into the first (n)(W) bytes of the first location.

- 42 -

32. The method of claim 31, wherein the copied first number (N) of data bytes and the copied (X) dummy bytes correspond to the first data word.

5 33. The method of claim 31, further comprising copying the (N) data bytes a remaining number of the data words into the remaining memory locations in accordance with (a) through (c).

10 34. The method of claim 33, wherein the interleaved data stream includes an interleave depth (D) and the method includes a memory access technique having at least first and second memory strides.

15 35. The method of claim 34, further comprising de-interleaving the data bytes in the memory based upon operation of the DMA engine, the DMA engine ignoring the dummy bytes (X).

36. The method of claim 35, wherein the de-interleaving is based upon operation of the DMA engine and at least the first and second strides.

20 37. The method of claim 36, wherein the de-interleaving occurs based upon the operation of the DMA engine, values of the first and second strides, an offset increment value, and an offset modulo value.

25 38. The method of claim 37, wherein a value of the first stride is equal to the interleave depth, and a value of the second stride is equal to the interleave depth plus (X).

39. The method of claim 38, wherein the second stride is used instead of the first stride; and

30 wherein the second stride is used based a modulo of the offset increment value.

- 43 -

40. An apparatus for de-interleaving a data stream stored in a buffer having a plurality of memory locations, each location having a memory width of (W) bytes, the data stream being formed of a number of data words each including (N) number of data bytes, wherein (N) is a non-integer multiple of the width (W), the apparatus comprising:

means for storing the data words into respective memory locations;

means for appending each of the stored data words with number (X) of dummy bytes, a sum of (N) + (X) being an integer multiple of the width (W); and

means for storing the appended dummy bytes into the respective memory locations.

41. The apparatus of claim 40, wherein the data words include codeword-size data blocks.

42. The apparatus of claim 41, wherein the interleaved data stream includes an interleave depth (D); and

wherein the apparatus is implemented based upon operation of a direct memory access (DMA) engine.

43. The apparatus of claim 42, further means for comprising de-interleaving the data bytes stored in the respective memory locations based upon operation of the DMA engine and a number of parameters;

wherein the parameters include first and second memory strides, an offset increment value, and an offset modulo value.

44. A circuit, comprising:

a fast fourier transform (FFT) address generator configured to produce a complex FFT address sequence, the complex FFT address sequence having fixed offsets; and

- 44 -

a conversion mechanism configured to (i) receive the complex FFT address sequence and (ii) convert the received sequence into an address sequence having varying offsets.

5           45.    The circuit of claim 44, wherein the circuit is included in a modem.

10           46.    The circuit of claim 45, wherein the modem is an asymmetric digital subscriber line (ADSL) modem.

          47.    The circuit of claim 44, wherein the conversion mechanism is an FFT post-processing module.

15           48.    The circuit of claim 44, wherein the varying offsets vary in a decreasing direction.

          49.    The circuit of claim 44, wherein the conversion mechanism performs the converting in lieu of FFT-post-processing.

20           50.    The circuit of claim 44, wherein the conversion mechanism includes:

25           a logic gate having first and second input ports and an output port, the first input port being coupled to an address generator output port, the output port being configured to output the address sequence having the varying offsets; and

          a mask generator having a third input port and an output port, the third input port being coupled to the address generator output port, and the mask generator output port being coupled to the second input.

30           51.    The circuit claim 50, wherein the logic gate is an exclusive OR gate.

- 45 -

52. A method for determining a fast fourier transform (FFT) post processing address sequence of an N-point FFT in a digital signal processor, the method comprising:

5 producing a complex FFT address sequence in response to N received complex FFT input samples, the complex FFT address sequence being representative of N/2 output address pairs having fixed offsets, the sequence including a bit stream having (n) data bits representative of a memory address of the output pairs, (N) being equal to  $2^n$ ;

10 selecting particular ones of the data bits for complementing; and performing an arithmetic operation between the selected particular ones of the bits and the complex FFT address sequence, the complement operation producing output address pairs having un-fixed offsets.

15 53. The method of claim 52, wherein the particular ones of the data bits include an (n-1) least significant bit (LSB).

54. The method of claim 53, wherein an LSB address[0] is 1.

20 55. The method of claim 52, wherein selecting is implemented based upon a masking operation.

56. The method of claim 52, wherein the arithmetic operation is a one's complement operation.

25 57. An apparatus for determining a fast fourier transform (FFT) post processing address sequence of an N-point FFT in a digital signal processor, the apparatus comprising:

30 means for producing a complex FFT address sequence in response to N received complex FFT input samples, the complex FFT address sequence being representative of (N/2) output address pairs having fixed offsets, the sequence including a bit stream having (n) data bits representative of a memory address of the output pairs, (N) being equal to  $2^n$ ;

- 46 -

means for selecting particular ones of the data bits for complementing;  
and

means for performing a arithmetic operation between the selected  
particular ones of the bits and the complex FFT address sequence, the  
5 complement operation producing output address pairs having un-fixed offsets.

58. The apparatus of claim 57, wherein the particular ones of the  
data bits include an (n-1) least significant bit (LSB).

10 59. The apparatus of claim 57, wherein an LSB address[0] is 1.

60. The apparatus of claim 57, wherein the selecting is  
implemented based upon a masking operation.

15 61. The apparatus of claim 57, wherein the arithmetic operation is a  
one's complement operation.

20 62. A method for implementing a SLICE operation in a  
programmable digital signal processor (DSP) as a primitive instruction in one  
or more data paths of at least one of (i) a single instruction single data scheme  
and (ii) a single instruction multiple data scheme.

25 63. The method of claim 62, wherein the SLICE instruction is  
executed in three or less input cycles.

64. The method of claim 62, wherein the SLICE operation includes  
an input symbol slicing stage and a quantization stage.

30 65. The method of claim 64, wherein the input symbol slicing stage  
occurs during a first input cycle and the quantization stage occurs during a  
second input cycle.



- 47 -

66. The method of claim 65, wherein the SLICE operation is configured to associate input symbol data with a particular point of a constellation grid, the constellation grid being stored in a memory of the DSP

5           67. A computer readable medium carrying one or more sequences of one or more instructions for execution by one or more processors to perform a method for implementing a SLICE operation in a programmable digital signal processor (DSP) as a primitive instruction in one or more data paths of a single instruction multiple data scheme.

10           68. A digital signal processor (DSP) including a number of single instruction multiple data (SIMD) path logic units, each logic unit including (i) a multiplier having two or more input ports, one of the input ports being configured to receive input symbol data, the multiplier being configured to produce a multiplier output, (ii) an adder configured to receive the output product and produce an adder output therefrom, and (iii) a scalar configured to scale the adder output, the DSP comprising:

15           a constants generator coupled to another one of the number of multiplier input ports and being configured to produce a fixed format signal based upon the input symbol data, the multiplier output being representative of a product of the received input symbol data and the fixed format signal;

20           wherein the adder is configured to (i) receive boundary constraints representative of a first component of predetermined symbol standards and (ii) compare the multiplier output with the boundary constraints, the adder output being representative of the comparison; and

25           a quantizer configured to (i) receive the adder output and (ii) associate the received adder output with a second component of the predetermined symbol standard, the quantizer producing a quantized output.

30           69. The DSP of claim 68, wherein the DSP includes a number of data paths, each of the logic units being respectively arrayed along one of the paths.

- 48 -

5           70.    The DSP of claim 68, wherein the constants generator produces the fixed format signal in accordance with the expression  $2^{(k-b)}$ , where (k) is a predetermined constant, and where (b) is indicative of fractional bits associated with the symbol data.

          71.    The DSP of claim 70, wherein the symbol standards are associated with a constellation grid; and  
10           wherein the constellation grid is formed of an infinite grid and a finite grid.

          72.    The DSP of claim 71, wherein the first component is the finite grid.

15           73.    The DSP of claim 72, wherein the bit stream includes least significant bits (LSBs) and the quantizer sets the LSBs to zero.

          74.    The DSP of claim 73, wherein the quantizer includes a logic array.  
20

          75.    The DSP of claim 13, wherein the quantizer includes a first logic gate having first and second input ports and a first output port, one of the first and second input ports being configured to receive the output sum and the other of the first and second input ports being configured to receive a control logic signal; and  
25

          a second logic gate having third and fourth input ports and a second output port, one of the third and fourth input ports being coupled to the first input port and the other of the third and fourth input ports being coupled to the second input port, the second output port being coupled to the first output port.  
30

          76.    The DSP of claim 75, wherein the first logic gate is an OR gate; and

- 49 -

wherein the second logic gate is an AND gate.

77. The DSP of claim 76, wherein the second component is a nearest point within the infinite grid.

78. The DPS of claim 77, further comprising an accumulator configured to (i) receive condition data representative of a location of the input symbol data and (ii) update the quantized output based upon the received condition data.

79. A method of slicing a receive data symbol in a digital signal processor including a number of single instruction multiple data path logic units, each logic unit including (i) a multiplier having two or more input ports, one of the input ports being configured to receive input symbol data, the multiplier being configured to produce a multiplier output, and (ii) an adder configured to receive the output product and produce an adder output therefrom, the method comprising:

producing a fixed format signal based upon the input symbol data, the fixed format signal being multiplied by the input symbol data to produce the multiplier output;

comparing the boundary constraints with the multiplier output, a result of the comparing being representative of the adder output; and

associating with a second component of the predetermined symbol standard.

80. The method of claim 79, wherein the fixed signal format is produced in accordance with the expression  $2^{(k-b)}$ , where (k) is a predetermined constant, and where (b) is indicative of fractional bits associated with the symbol data.

81. The method of claim 79, wherein the fixed format signal is formed of a bit stream having a fixed binary point.

- 50 -

82. The method of claim 79, wherein the input signal includes a phase component and a magnitude component.

5           83. The method of claim 79, wherein the symbol standards are associated with a constellation grid.

84. The method of claim 83, wherein the constellation grid is formed of an infinite grid and a finite grid.

10           85. The method of claim 84, wherein the first component is the finite grid.

86. A method for sharing one or more memories between one or more processors, each memory being associated with a respective ownership flag, the method comprising:

15           associating each of the processors with a particular value of the flag;  
and  
            assigning use of the memories to a corresponding one of the processors  
20           when the respective ownership flag is set to the particular value.

87. The method of claim 86, wherein each of the processors is associated with a different particular value.

25           88. The method of claim 87, wherein the particular values are changeable in association with selected processor cycles.

89. The method of claim 88, wherein the use of a particular memory includes ownership of the memory during the during the selected  
30           processor cycle.

- 51 -

90. The method of claim 89, wherein each memory is assigned to only one processor during any one of the processor cycles.

5 91. An apparatus for sharing one or more memories between one or more processors, each memory being associated with a respective ownership flag, the apparatus comprising:

means for associating each of the processors with a particular value of the flag; and

10 means for assigning use of the memories to a corresponding one of the processors when the respective ownership flag is set to the particular value.

92. The apparatus of 91, wherein each of the processors is associated with a different particular value.

15 93. The apparatus of claim 92, wherein the particular values are changeable in association with selected processor cycles.

20 94. The apparatus of claim 93, wherein the use of a particular memory includes ownership of the memory during the during the selected processor cycle.

95. The apparatus of claim 94, wherein each memory is assigned to only one processor during any one of the processor cycles.

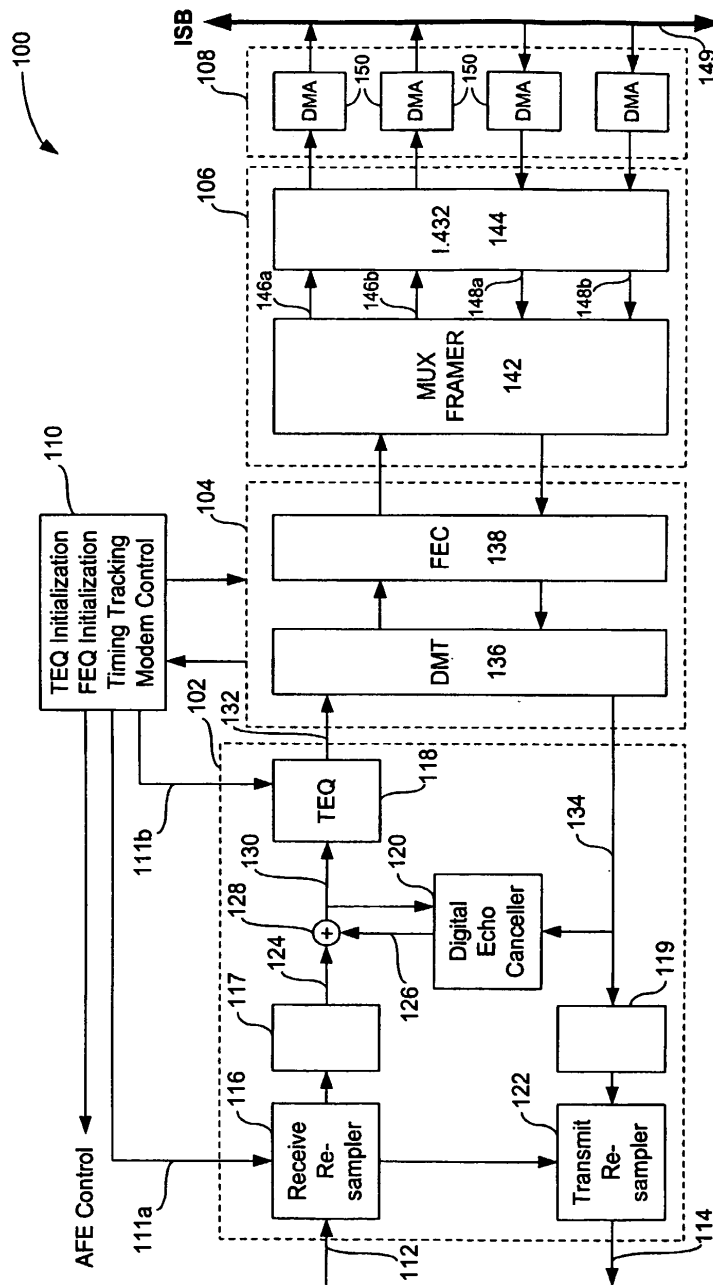


FIG. 1

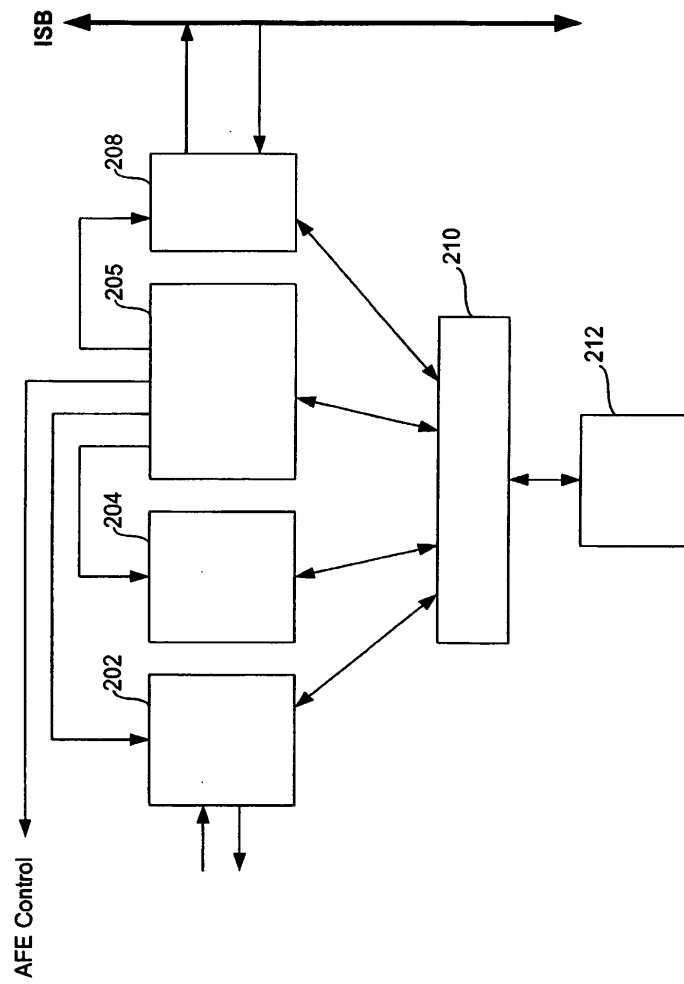


FIG. 2

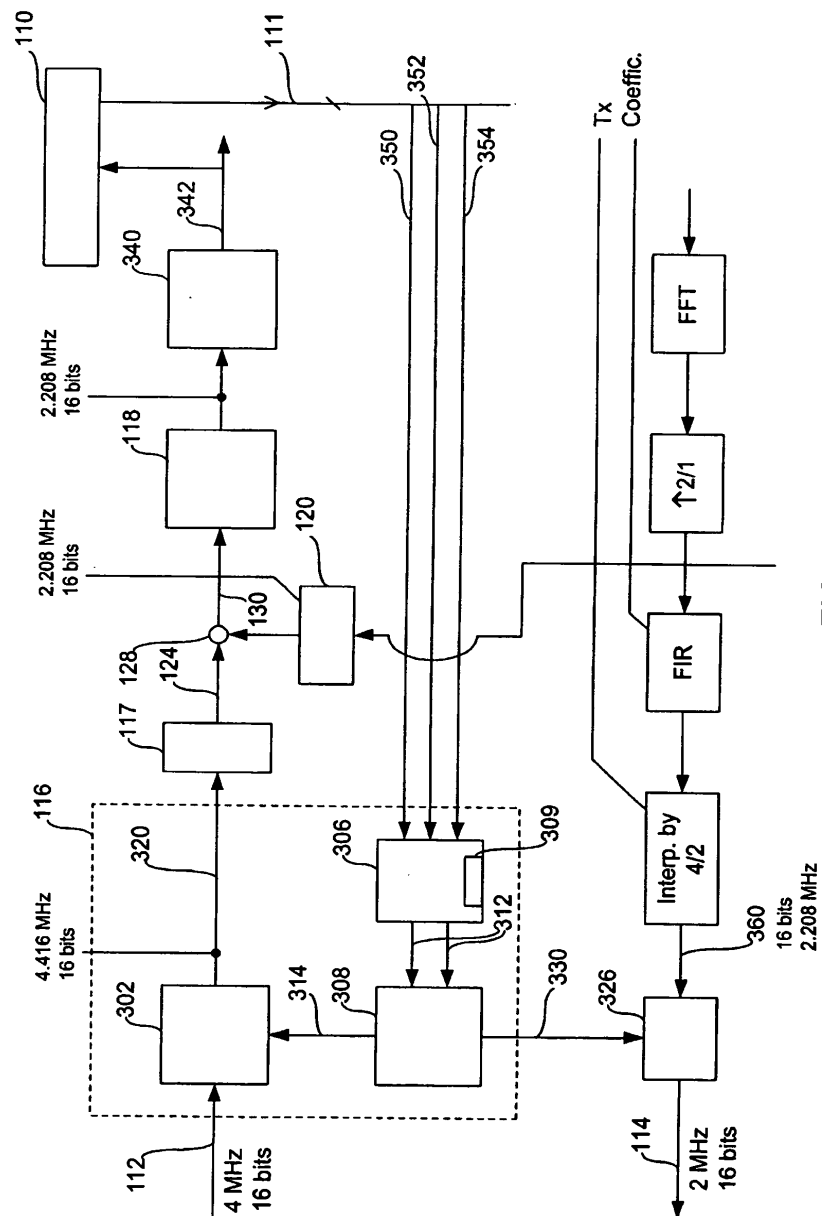


FIG. 3



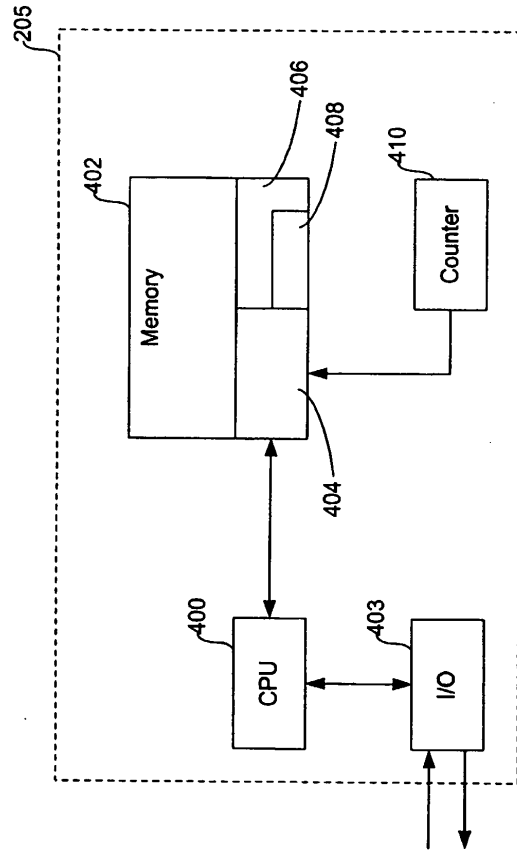


FIG. 4

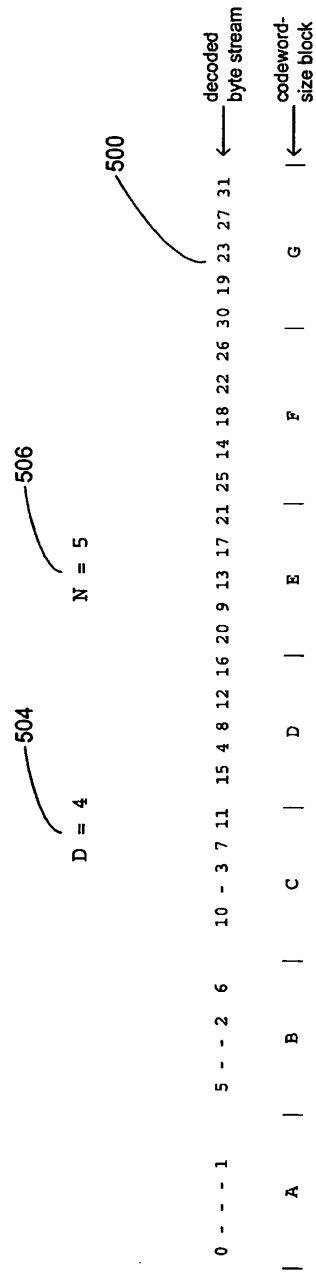


FIG. 5

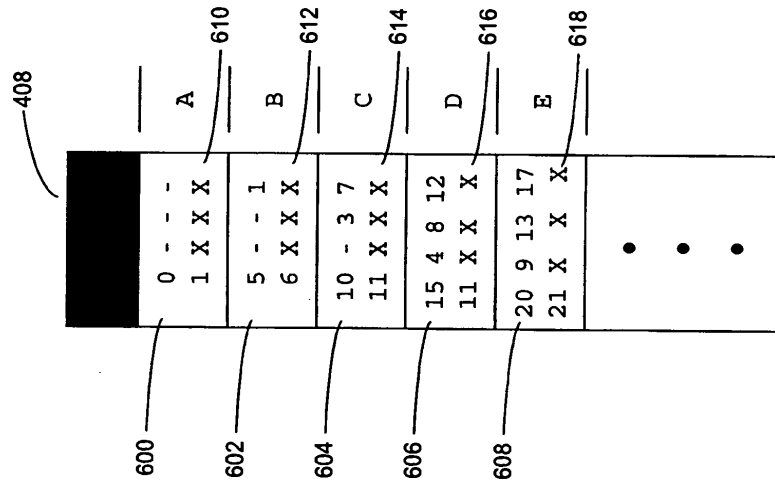


FIG. 6

DMA Parameters:    Stride       = 4  
                     Stride2     = 4 + 3 = 7  
                     Offset      = 0  
                     Offset INC = 4  
                     Offset Mod = 5

**FIG. 7**

DMA Address Sequence:

| <u>Step</u> | <u>Offset</u> | <u>Address</u> |
|-------------|---------------|----------------|
| 0           | 0             | A              |
| 1           | 4             | A+4            |
| 2           | 3             | A+11           |
| 3           | 2             | A+18           |
| 4           | 1             | A+25           |

FIG. 8

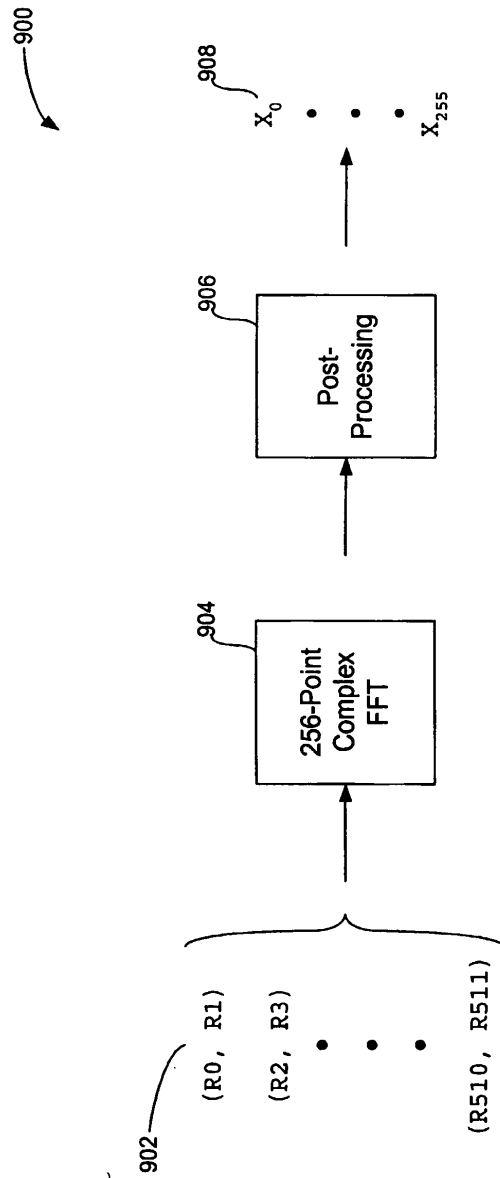


**FIG. 9**  
(conventional)

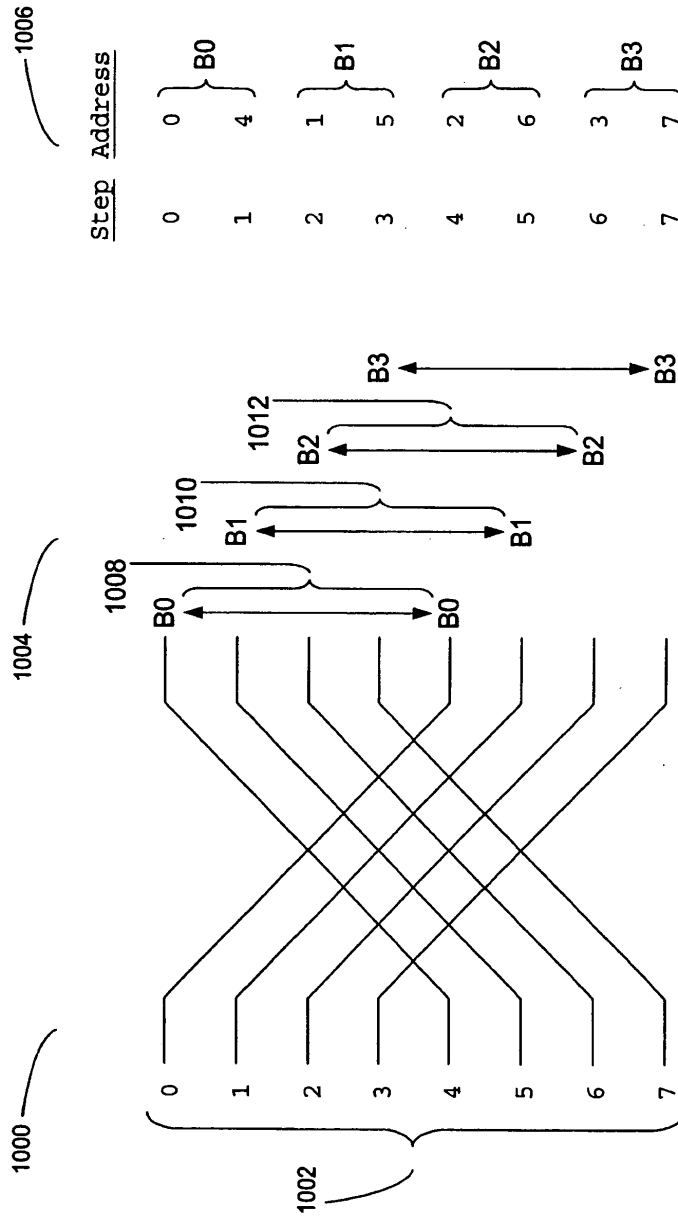


**FIG. 10**  
(conventional)

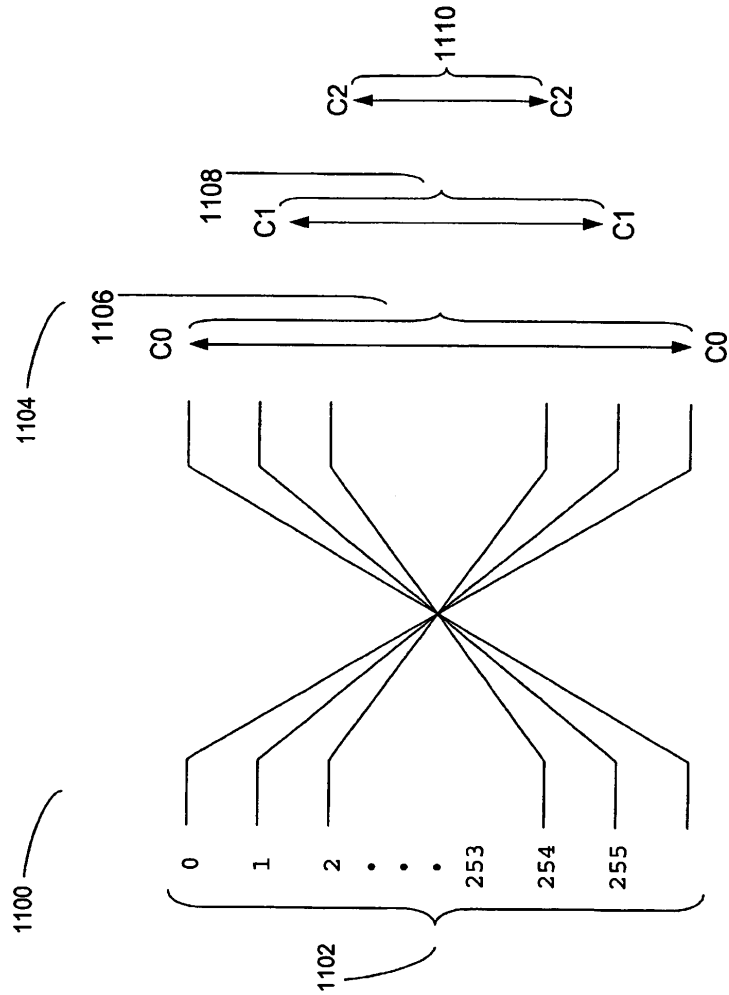
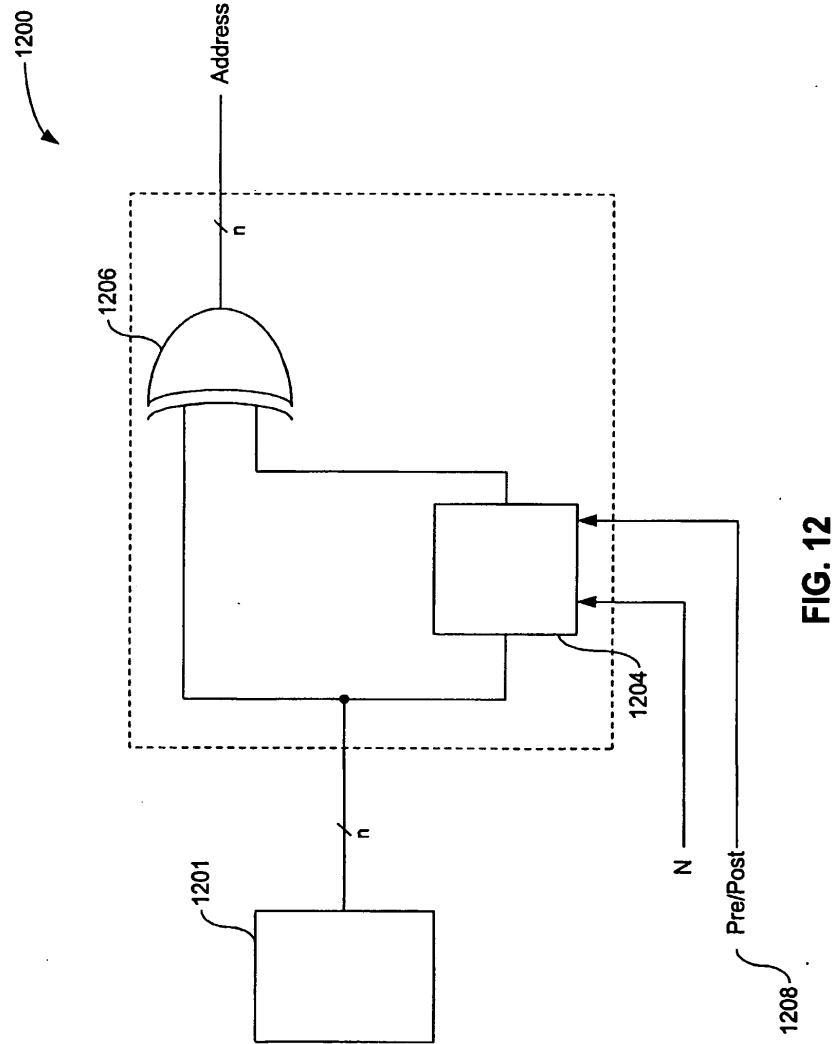


**FIG. 11**  
(conventional)





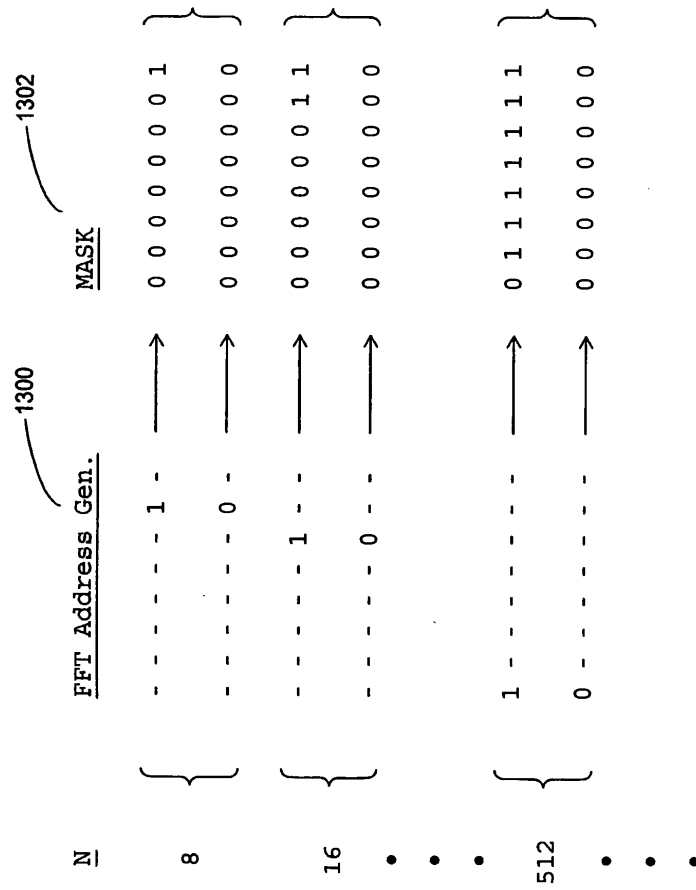


FIG. 13

| <u>STEP</u> | <u>FFT Address Gen.</u> | <u>Conditionally Inverted Address</u> |
|-------------|-------------------------|---------------------------------------|
| 2           | 1                       | 1                                     |
| 3           | 128                     | 255                                   |
| 4           | 2                       | 2                                     |
| 5           | 127                     | 254                                   |
| 6           | 3                       | 3                                     |
| 7           | 130                     | 253                                   |
| •           |                         |                                       |
| •           |                         |                                       |
| •           |                         |                                       |
| 254         | 127                     | 127                                   |
| 255         | 254                     | 129                                   |

**FIG. 14**

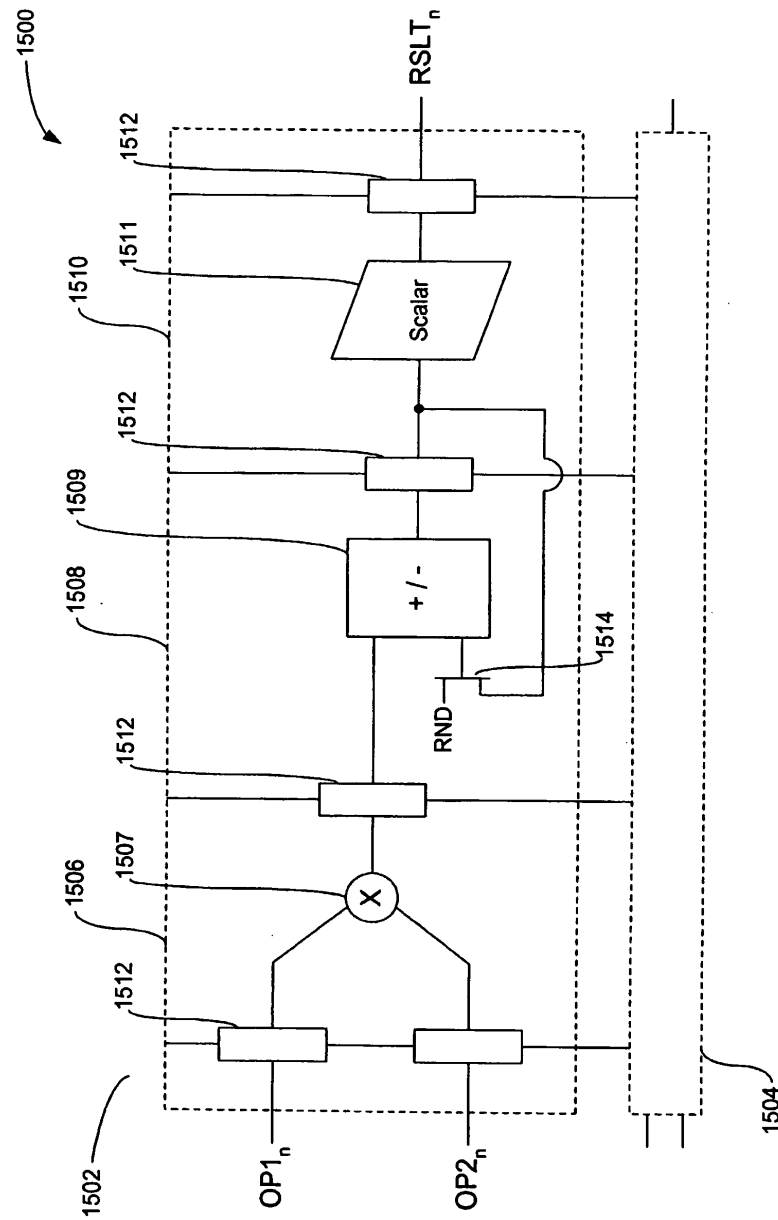


**FIG. 15**  
(conventional)

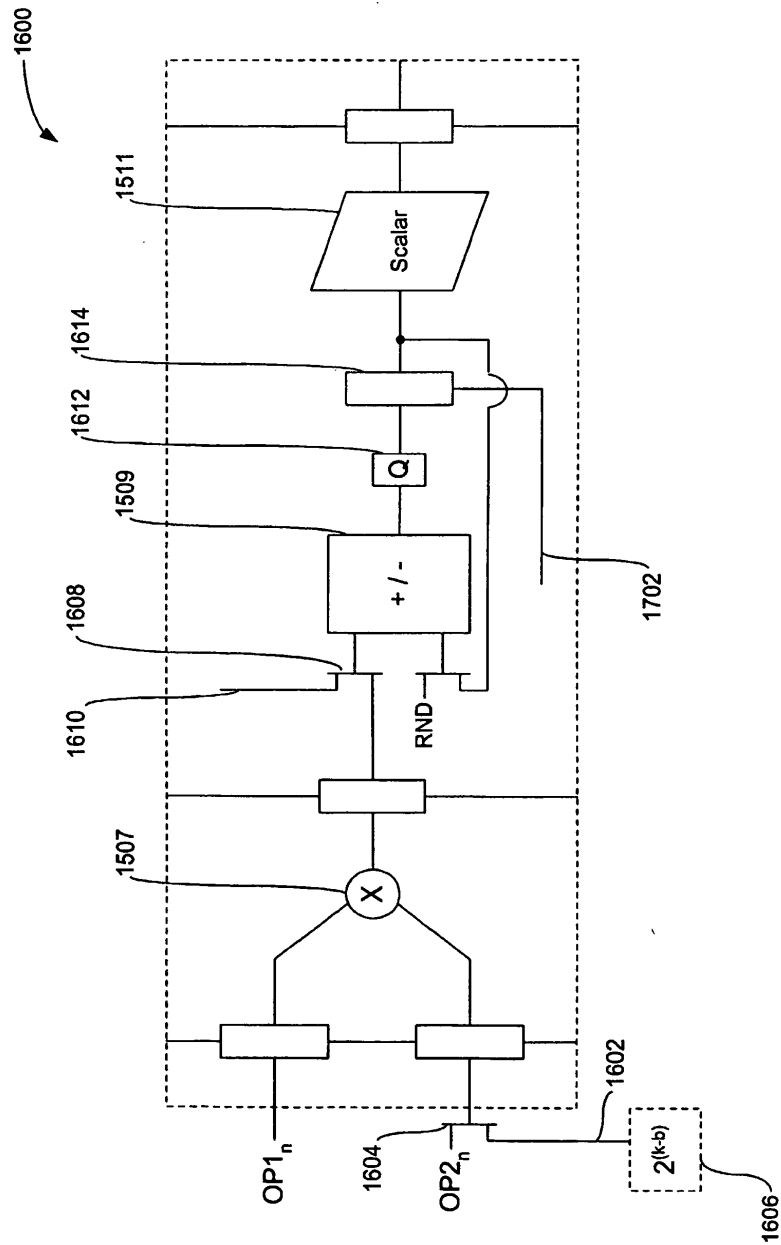


FIG. 16

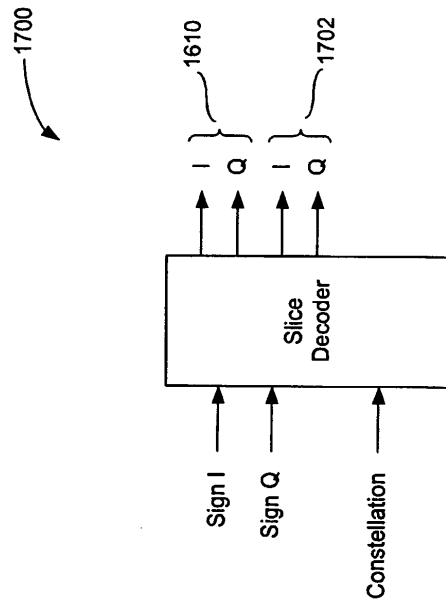


FIG. 17

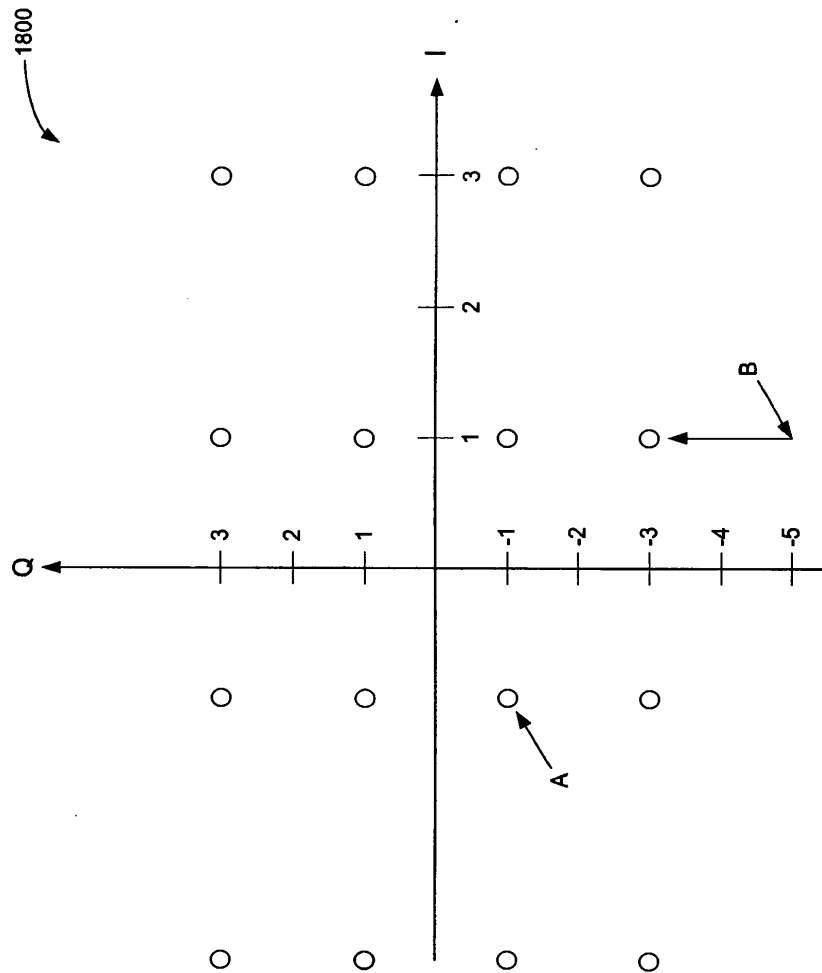


FIG. 18

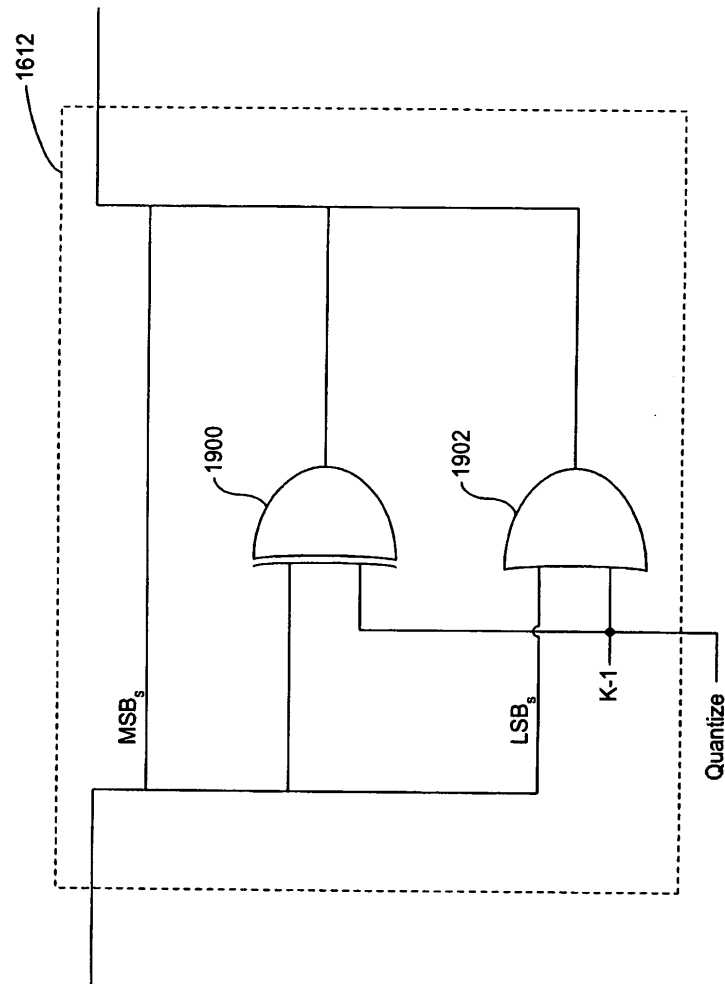


FIG. 19



|     | Cycle | Quantize | I Limit | I Condition | Q Limit | Q Condition | Acc I | Acc Q |
|-----|-------|----------|---------|-------------|---------|-------------|-------|-------|
| 'A' | 1     | Yes      | -       | -           | -       | -           | -1    | -1    |
|     | 2     | No       | -3      | <           | -3      | <           | -1    | -1    |
| 'B' | 1     | Yes      | -       | -           | -       | -           | -1    | -5    |
|     | 2     | No       | 3       | ≥           | -3      | <           | -1    | -3    |

FIG. 20

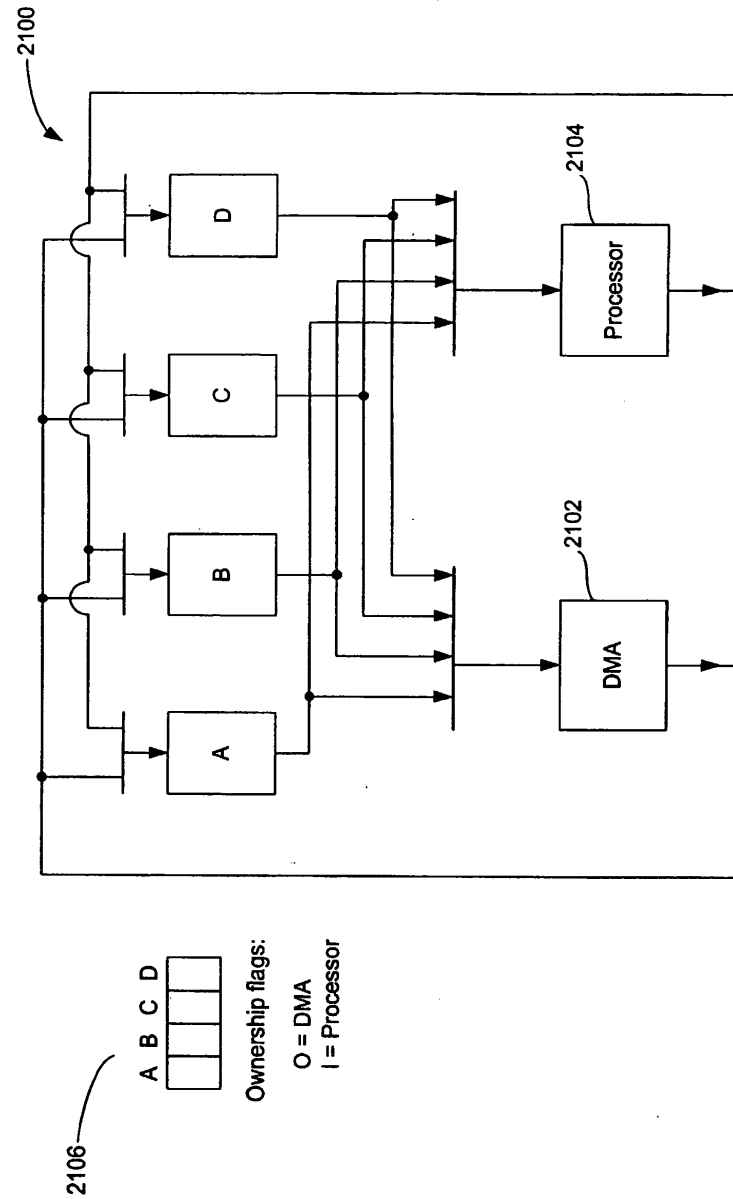


FIG. 21

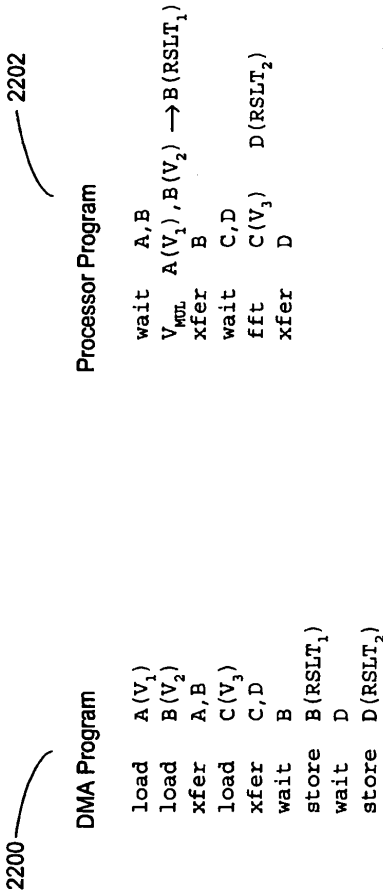


FIG. 22

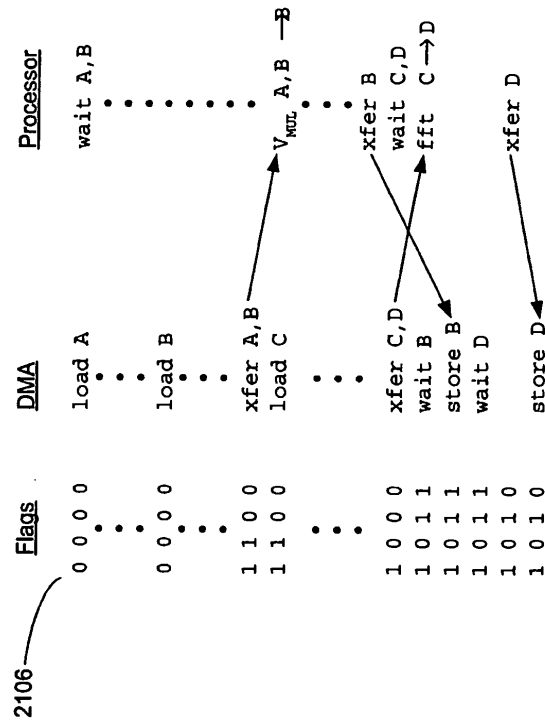


FIG. 23

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
31 July 2003 (31.07.2003)

PCT

(10) International Publication Number  
WO 03/063060 A3

(51) International Patent Classification<sup>7</sup>: H04L 5/16

(21) International Application Number: PCT/US03/02154

(22) International Filing Date: 24 January 2003 (24.01.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
60/350,253 24 January 2002 (24.01.2002) US

(71) Applicant: BROADCOM CORPORATION [US/US];  
16215 Alton Parkway, Irvine, CA 92618 (US).

(72) Inventors: EFLAND, Gregory, H.; 2225 Ramona Street,  
Palo Alto, CA 94301 (US). LIANG, Haixiang; 1403  
Pitman Avenue, Palo Alto, CA 94310 (US). PETERSON,  
kevin, H.; 725 Leona Lane, Mountain View, CA 94040  
(US). CHEN, Yuanjie; 5215 Nice Court, San Jose, CA  
95138 (US). CORRY, Alan, G.; 900 Pepper Tree Lane,  
# 621, Santa Clara, CA 95051 (US). FERRARIO, Nino,  
P.; 718 Old San Francisco Road, Apartment # 329, Sun-  
nyvale, CA 94086 (US). GUAN, Jeff, Z.; 908 Bentley  
Oaks Court, San Ramon, CA 94583 (US). PRAHLAD,  
Meera; 19523 Dorchester Drive, Saratoga, CA 95070  
(US). STOMAKHIN, Ilya; 10330 Imperial Avenue,

Cupertino, CA 95014 (US). WAN, Yongbing; 4231 Ruby  
Avenue, San Jose, CA 95135 (US). YAMANO, Larry,  
C.; 838 Gary Avenue, Sunnyvale, CA 94086 (US). YIN,  
Lin; 41741 Vaquero Court, Fremont, CA 94539 (US).  
YU, Gong-San; 325 Tramway Drive, Milpitas, CA 95035  
(US). PAPANICOLAOU, George, A.; 342 Lawson Road,  
Scarborough, Ontario M1C 2J9 (CA).

(74) Agents: SOKOHL, Robert et al.; Sterne, Kessler, Gold-  
stein & Fox P.L.L.C., Suite 600, 1100 New York Avenue,  
N.W., Washington, D.C. 20005-3934 (US).

(84) Designated States (regional): European patent (AT, BE,  
BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU,  
IE, IT, LU, MC, NL, PT, SE, SI, SK, TR).

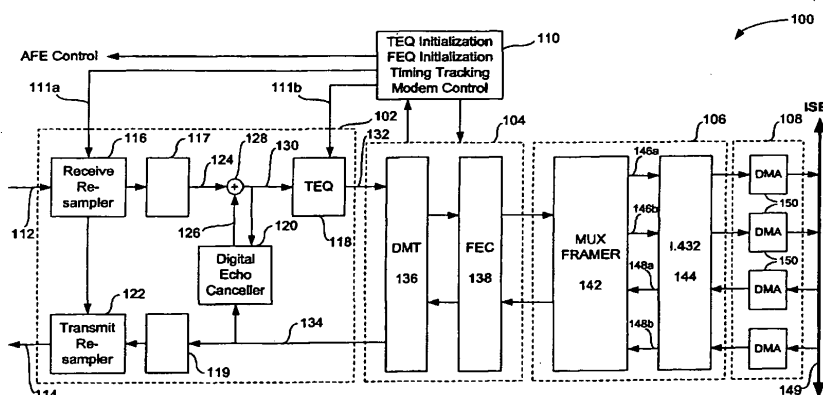
Published:

- with international search report
- before the expiration of the time limit for amending the  
claims and to be republished in the event of receipt of  
amendments

(88) Date of publication of the international search report:  
16 October 2003

For two-letter codes and other abbreviations, refer to the "Guid-  
ance Notes on Codes and Abbreviations" appearing at the begin-  
ning of each regular issue of the PCT Gazette.

(54) Title: ASYMMETRIC DIGITAL SUBSCRIBER LINE MODEM APPARATUS AND METHODS THEREFOR



(57) Abstract: Provided is a system and method for a modem (100) including one or more processing paths. Also included is a number of interconnected modules (102) (104) (106) (108) sequentially arrayed along the one or more paths. Each module is configured to (i) process signals passed along the paths in accordance with the sequence and (ii) implement predetermined functions to perform the processing. Further, each of the modules has a particular degree of functional programmability and the degrees of functional programmability monotonically vary in accordance with the sequence.

WO 03/063060 A3

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/02154

| <b>A. CLASSIFICATION OF SUBJECT MATTER</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                  |                                                                                       |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|-----------------------------------------------|--------------------------------------------------------------------------------------------------------|--|
| IPC(7) : H04L 5/16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                  |                                                                                       |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| US CL : 375/219,220,222,232,260,262,265,356;370/210,286,289,290,464,480,503,525;711/127;708/313,400,404                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                  |                                                                                       |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| According to International Patent Classification (IPC) or to both national classification and IPC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                  |                                                                                       |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| <b>B. FIELDS SEARCHED</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                  |                                                                                       |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| Minimum documentation searched (classification system followed by classification symbols)<br>U.S. : 375/219,220,222,232,260,262,265,356;370/210,286,289,290,464,480,503,525;711/127;708/313,400, 404                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                  |                                                                                       |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                                       |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)<br>EAST Database                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                                       |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                                       |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| Category *                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                               | Relevant to claim No.                                                                 |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | US 5,909,463 A (JOHNSON ET AL.) 01 June 1999, see the entire patent.                                                                                                                                                                             | 1-26                                                                                  |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | US 5,742,527 A (RYBICKI ET AL.) 21 April 1998, see the entire patent.                                                                                                                                                                            | 1-26                                                                                  |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | US 5,309,484 A (MCLANE ET AL.) 03 May 1994, see the entire patent.                                                                                                                                                                               | 1-26                                                                                  |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | US 4,074,086 A (FALCONER ET AL.) 14 February 1978, see the entire patent.                                                                                                                                                                        | 1-26                                                                                  |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | US 6,219,816 B1 (TEZUKA) 17 April 2001, see the entire patent.                                                                                                                                                                                   | 27-42                                                                                 |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | US 6,202,178 B1 (SPRUYT) 13 March 2001, see the entire patent.                                                                                                                                                                                   | 27-42                                                                                 |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | US 6,035,313 A (MARCHANT) 07 March 2000, see the entire patent.                                                                                                                                                                                  | 44-61                                                                                 |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | US 5,491,652 A (LUO ET AL.) 13 February 1996, see the entire patent.                                                                                                                                                                             | 44-61                                                                                 |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | US 4,982,428 A (AGAZZI ET AL.) 01 January 1991, see the entire patent.                                                                                                                                                                           | 62-85                                                                                 |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                  |                                                                                       |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| * Special categories of cited documents: <table border="0"> <tr> <td>"A" document defining the general state of the art which is not considered to be of particular relevance</td> <td>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>"E" earlier application or patent published on or after the international filing date</td> <td>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>"O" document referring to an oral disclosure, use, exhibition or other means</td> <td>"&amp;" document member of the same patent family</td> </tr> <tr> <td>"P" document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table> |                                                                                                                                                                                                                                                  |                                                                                       | "A" document defining the general state of the art which is not considered to be of particular relevance | "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention | "E" earlier application or patent published on or after the international filing date | "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone | "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) | "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art | "O" document referring to an oral disclosure, use, exhibition or other means | "&" document member of the same patent family | "P" document published prior to the international filing date but later than the priority date claimed |  |
| "A" document defining the general state of the art which is not considered to be of particular relevance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention                                              |                                                                                       |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| "E" earlier application or patent published on or after the international filing date                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone                                                                     |                                                                                       |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art |                                                                                       |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| "O" document referring to an oral disclosure, use, exhibition or other means                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | "&" document member of the same patent family                                                                                                                                                                                                    |                                                                                       |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| "P" document published prior to the international filing date but later than the priority date claimed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                  |                                                                                       |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| Date of the actual completion of the international search<br>13 June 2003 (13.06.2003)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                  | Date of mailing of the international search report<br><b>19 AUG 2003</b>              |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |
| Name and mailing address of the ISA/US<br>Mail Stop PCT, Attn: ISA/US<br>Commissioner for Patents<br>P.O. Box 1450<br>Alexandria, Virginia 22313-1450<br>Facsimile No. (703)305-3230                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                  | Authorized officer<br>Chi Pham<br>Telephone No. 703-305-3800<br><i>Kuzenica Zogor</i> |                                                                                                          |                                                                                                                                                                                                     |                                                                                       |                                                                                                                                                                              |                                                                                                                                                                         |                                                                                                                                                                                                                                                  |                                                                              |                                               |                                                                                                        |  |

Form PCT/ISA/210 (second sheet) (July 1998)

# INTERNATIONAL SEARCH REPORT

PCT/US03/02154

## C. (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|------------------------------------------------------------------------------------|-----------------------|
| Y ✓        | US 5,671,250 A (BREMER ET AL.) 23 September 1997, see the entire patent.           | 62-85                 |
| Y ✓        | US 5,872,993 A (BROWN) 16 February 1999, see the entire patent.                    | 86-95                 |
| Y ✓        | US 6,256,723 B1 (HUDSON ET AL.) 3 July 2001, see the entire patent.                | 86-95                 |

Form PCT/ISA/210 (second sheet) (July 1998)

**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☒ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☐ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**



(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
27 April 2006 (27.04.2006)

PCT

(10) International Publication Number  
WO 2006/044227 A1

(51) International Patent Classification:  
H04L 1/00 (2006.01) H04L 27/26 (2006.01)

(21) International Application Number:  
PCT/US2005/036015

(22) International Filing Date: 11 October 2005 (11.10.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
60/618,269 12 October 2004 (12.10.2004) US

(71) Applicant (for all designated States except US): AWARE, INC. [US/US]; 40 Middlesex Turnpike, Bedford, MA 01730-1432 (US).

(72) Inventors: TZANNES, Marcos, C.; 121 La Espiral, Orinda, CA 94563 (US). LUND, Michael; 110 Prospect St., West Newton, MA 02465 (US).

(74) Agent: VICK, Jason, H.; Miles & Stockbridge P.C., 1751 Pinnacle Dr., Suite 500, McLean, VA 22102 (US).

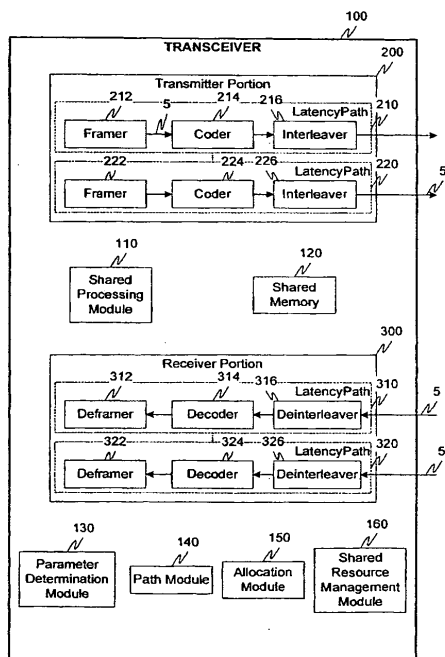
(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:  
— with international search report

[Continued on next page]

(54) Title: RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT



(57) Abstract: A transceiver is designed to share memory and processing power amongst a plurality of transmitter and/or receiver latency paths, in a communications transceiver that carries or supports multiple applications. For example, the transmitter and/or receiver latency paths of the transceiver can share an interleaver/deinterleaver memory. This allocation can be done based on the data rate, latency, BER, impulse noise protection requirements of the application, data or information being transported over each latency path, or in general any parameter associated with the communications system.

WO 2006/044227 A1



*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT**RELATED APPLICATION DATA

[0001] This application claims the benefit of and priority under 35 U.S.C. § 119(e) to U.S. Patent Application No. 60/618,269, filed October 12, 2004, entitled "Sharing Memory and Processing Resources in DSL Systems," which is incorporated herein by reference in its entirety.

BACKGROUNDField of the Invention

[0002] This invention generally relates to communication systems. More specifically, an exemplary embodiment of this invention relates to memory sharing in communication systems. Another exemplary embodiment relates to processing or coding resource sharing in a communication system.

Description of Related Art

[0003] U.S. Patent Nos. 6,775,320 and 6,778,589, which are both incorporated herein by reference in their entirety, describe DSL systems supporting multiple applications and multiple framer/coder/interleaver FCI blocks (an FCI block is also referred to as a latency path). DSL systems carry applications that have different transmission requirements with regard to, for example, data rate, latency (delay), bit error rate (BER), and the like. For example, video typically requires a low BER ( $<1E-10$ ) but can tolerate higher latency ( $>20$  ms). Voice, on the other hand, typically requires a low latency ( $<1$  ms) but can tolerate BER ( $>1E-3$ ).

[0004] As described in U.S. Patent No. 6,775,320, different applications can use different latency paths in order to satisfy the different application requirements of the communication system. As a result a transceiver must support multiple latency paths in order to support applications such as video, Internet access and voice telephony. When implemented in a transceiver, each of the latency paths will have a framer, coder, and interleaver block with different capabilities that depend on the application requirements.

#### SUMMARY

[0005] One difficulty with implementing multiple latency paths in a transceiver is the fact that a latency path is a complicated digital circuit that requires a large amount of memory and processing power. An interleaver within a latency path can consume a large amount of memory in order to provide error correcting capability. For example, a typical DSL transceiver will have at least one latency path with approximately 16 kbytes of memory for the interleaver. Likewise, the coding block, for example, a Reed Solomon coder, consumes a large amount of processing power. In general, as the number of latency paths increase, the memory and processing power requirements for a communication system become larger.

[0006] Accordingly, an exemplary aspect of this invention relates to sharing memory between one or more interleavers and/or deinterleavers in a transceiver. More particularly, an exemplary aspect of this invention relates to shared latency path memory in a transceiver.

[0007] Additional aspects of this invention relate to configuring and initializing shared memory in a communication system. More particularly, an exemplary aspect of this invention relates to configuring and initializing interleaver/deinterleaver memory in a communication system.

[0008] Additional aspects of the invention relate to determining the amount of memory that can be allocated to a particular component by a communication system. More specifically, an exemplary aspect of the invention relates to determining the maximum amount of shared memory that can be allocated to one or more interleaves or deinterleavers.

[0009] According to another exemplary aspect of the invention, processing power is shared between a number of transceiver modules. More specifically, and in accordance with an exemplary embodiment of the invention, a coding module is shared between one or more coders and/or decoders.

[0010] Another exemplary embodiment of the invention relates to transitioning from a fixed memory configuration to a shared memory configuration during one or more of initialization and SHOWTIME (user data transmission).

[0011] An additional exemplary aspect of the invention relates to dynamically updating one or more of shared memory and processing resources based on changing communication conditions.

**[0012]** An additional exemplary aspect of the invention relates to updating one or more of shared memory and processing resources based on an updated communication parameter.

**[0013]** An additional exemplary aspect of the invention relates to updating the allocation of one or more of shared memory and processing resources based on an updated communication parameter(s).

**[0014]** Additional aspects of the invention relate to exchanging shared resource allocations between transceivers.

**[0015]** Additional exemplary aspects relate to a method of allocating shared memory in a transceiver comprising allocating the shared memory to a plurality of modules, wherein each of the plurality of modules comprise at least one interleaver, at least one deinterleaver or a combination thereof.

**[0016]** Still further aspects relate to the above method wherein the plurality of modules comprise interleavers.

**[0017]** Still further aspects relate to the above method wherein the plurality of modules comprise deinterleavers.

**[0018]** Still further aspects relate to the above method wherein the plurality of modules comprise at least one interleaver and at least one deinterleaver.

**[0019]** Additional exemplary aspects relate to a transceiver comprising a plurality of modules each including at least one interleaver, at least one deinterleaver or a

combination thereof and a shared memory designed to be allocated to a plurality of the modules.

[0020] Still further aspects relate to the above transceiver wherein the plurality of modules comprise interleavers.

[0021] Still further aspects relate to the above transceiver wherein the plurality of modules comprise deinterleavers.

[0022] Still further aspects relate to the above transceiver wherein the plurality of modules comprise at least one interleaver and at least one deinterleaver.

[0023] These and other features and advantages of this invention are described in, or are apparent from, the following description of the embodiments.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The embodiments of the invention will be described in detail, with reference to the following figures, wherein:

[0025] Fig. 1 is a functional block diagram illustrating an exemplary transceiver according to this invention;

[0026] Fig. 2 is a flowchart outlining an exemplary method of sharing resources according to this invention;

[0027] Fig. 3 is a flowchart outlining an exemplary method of determining a maximum amount of shared memory according to this invention; and

[0028] Fig. 4 is a flowchart outlining an exemplary resource sharing methodology according to this invention.

### DETAILED DESCRIPTION

[0029] The exemplary embodiments of this invention will be described in relation to sharing resources in a wired and/or wireless communications environment. However, it should be appreciated, that in general, the systems and methods of this invention will work equally well for any type of communication system in any environment.

[0030] The exemplary systems and methods of this invention will also be described in relation to multicarrier modems, such as DSL modems and VDSL modems, and associated communication hardware, software and communication channels. However, to avoid unnecessarily obscuring the present invention, the following description omits well-known structures and devices that may be shown in block diagram form or otherwise summarized.

[0031] For purposes of explanation, numerous details are set forth in order to provide a thorough understanding of the present invention. It should be appreciated however that the present invention may be practiced in a variety of ways beyond the specific details set forth herein.

[0032] Furthermore, while the exemplary embodiments illustrated herein show the various components of the system collocated, it is to be appreciated that the various components of the system can be located at distant portions of a distributed



network, such as a telecommunications network and/or the Internet, or within a dedicated secure, unsecured and/or encrypted system. Thus, it should be appreciated that the components of the system can be combined into one or more devices, such as a modem, or collocated on a particular node of a distributed network, such as a telecommunications network. As will be appreciated from the following description, and for reasons of computational efficiency, the components of the system can be arranged at any location within a distributed network without affecting the operation of the system. For example, the various components can be located in a Central Office modem (CO, ATU-C, VTU-O), a Customer Premises modem (CPE, ATU-R, VTU-R), a DSL management device, or some combination thereof. Similarly, one or more functional portions of the system could be distributed between a modem and an associated computing device.

[0033] Furthermore, it should be appreciated that the various links, including communications channel 5, connecting the elements can be wired or wireless links, or any combination thereof, or any other known or later developed element(s) that is capable of supplying and/or communicating data to and from the connected elements. The term module as used herein can refer to any known or later developed hardware, software, firmware, or combination thereof that is capable of performing the functionality associated with that element. The terms determine, calculate and compute, and variations thereof, as used herein are used interchangeably and include any type of methodology, process, mathematical operation or technique. FCI block and latency path are used interchangeably herein as well as transmitting modem and transmitting transceiver. Receiving modem and receiving transceiver are also used

interchangeably.

[0034] Fig. 1 illustrates an exemplary embodiment of a transceiver 100 that utilizes shared resources. It should be appreciated that numerous functional components of the transceiver have been omitted for clarity. However, the transceiver 100 can also include the standard components found in typical communications device(s) in which the technology of the subject invention is implemented into.

[0035] According to an exemplary embodiment of the invention, memory and processing power can be shared among a plurality of transmitter and/or receiver latency paths, in a communications transceiver that carries or supports multiple applications. For example, the transmitter and/or receiver latency paths of the transceiver can share an interleaver/deinterleaver memory and the shared memory can be allocated to the interleaver and/or deinterleaver of each latency path. This allocation can be done based on the data rate, latency, BER, impulse noise protection requirements of the application, data or information being transported over each latency path, or in general any parameter associated with the communications system.

[0036] Likewise, for example, the transmitter and/or receiver latency paths can share a Reed-Solomon coder/decoder processing module and the processing power of this module can be allocated to each encoder and/or decoder. This allocation can be done based on the data rate/latency, BER, impulse noise protection requirements of the application data or information being transported over each latency path, or in general based on any parameter associated with the communication system.

[0037] In accordance with an exemplary operational embodiment, a first transceiver and a second transceiver transmit to one another messages during, for example, initialization which contain information on the total and/or shared memory capabilities of each transceiver and optionally information about the one or more latency paths. This information can be transmitted prior to determining how to configure the latency paths to support the application requirements. Based on this information, one of the modems can select an FCI configuration parameter(s) that meets the transmission requirements of each application being transported over each latency paths. While an exemplary of the embodiment of the invention will be described in relation to the operation of the invention and characteristics thereof being established during initialization, it should be appreciated that the sharing of resources can be modified and messages transmitted between a two transceivers at any time during initialization and/or user data transmission, i.e., SHOWTIME.

[0038] Fig. 1 illustrates an exemplary embodiment of a transceiver 100. The transceiver 100 includes a transmitter portion 200 and a receiver portion 300. The transmitter portion 200 includes one or more latency paths 210, 220, .... Similarly, the receiver portion 300 includes one or more latency paths 310, 320, .... Each of the latency paths in the transmitter portion 200 includes a framer, coder, and interleaver designated as 212, 214, 216 and 222, 224 and 226, respectively. Each of the latency paths in the receiver portion includes a deframer, decoder, and deinterleaver designated as 312, 314, 316 and 322, 324, and 326, respectively. The transceiver 100 further includes a shared processing module 110, a shared memory 120, a parameter

determination module 130, a path module 140, an allocation module 150, and a shared resource management module 160, all interconnected by one or more links (not shown).

[0039] In this exemplary embodiment, the transceiver 100 is illustrated with four total transmitter portion and receiver portion latency paths, i.e., 210, 220, 310, and 320. The shared memory 120 is shared amongst the two transmitter portion interleavers 216 and 226 and two receiver portion deinterleavers 316 and 326. The shared processing module 110, such as a shared coding module, is shared between the two transmitter portion coders 214 and 224 and the two receiver portion decoders 314 and 324.

[0040] While the exemplary embodiment of the invention will be described in relation to a transceiver having a number of transmitter portion latency paths and receiver portion latency paths, it should be appreciated that this invention can be applied to any transceiver having any number of latency paths. Moreover, it should be appreciated that the sharing of resources can be allocated such that one or more of the transmitter portion latency paths are sharing a shared resource, one or more of the receiver portion latency paths are sharing a shared resource, or a portion of the transmitter portion latency paths and a portion of the receiver portion latency paths are sharing shared resources. Moreover, any one or more of the latency paths, or portions thereof, could also be assigned to a fixed resource while, for example, another portion of the latency path(s) assigned to a shared resource. For example, in latency path 210, the interleaver 216 could be allocated a portion of the shared

memory 120, while the coder 214 could be allocated to a dedicated processing module, vice versa, or the like.

[0041] In accordance with the exemplary embodiment, a plurality of transmitter portion or receiver portion latency paths share an interleaver/deinterleaver memory, such as shared memory 120, and a coding module, such as shared processing module 110. For example, the interleaver/deinterleaver memory can be allocated to different interleavers and/or deinterleavers. This allocation can be based on parameters associated with the communication systems such as data rate, latency, BER, impulse noise protection, and the like, of the applications being transported. Similarly, a coding module, which can be a portion of the shared processing module 110, can be shared between any one or more of the latency paths. This sharing can be based on requirements such as data rate, latency, BER, impulse noise protection, and the like, of the applications being transported.

[0042] For example, an exemplary transceiver could comprise a shared interleaver/deinterleaver memory and could be designed to allocate a first portion of the shared memory 120 to an interleaver, such as interleaver 216 in the transmitter portion of the transceiver and allocate a second portion of the shared memory 120 to a deinterleaver, such as 316, in the receiver portion of the transceiver.

[0043] Alternatively, for example, an exemplary transceiver can comprise a shared interleaver/deinterleaver memory, such as shared memory 120, and be designed to allocate a first portion of shared memory 120 to a first interleaver, e.g.,

216, in the transmitter portion of the transceiver and allocate a second portion of the shared memory to a second interleaver, e.g., 226, in the transmitter portion of the transceiver.

[0044] Alternatively, for example, an exemplary transceiver can comprise a shared interleaver/deinterleaver memory and be designed to allocate a first portion of the shared memory 120 to a first deinterleaver, e.g., 316, in the receiver portion of the transceiver and allocate a second portion of the shared memory to a second deinterleaver, e.g., 326, in the receiver portion of the transceiver. Regardless of the configuration, in general any interleaver or deinterleaver, or grouping thereof, be it in a transmitter portion or receiver portion of the transceiver, can be associated with a portion of the shared memory 120.

[0045] Establishment, configuration and usage of shared resources is performed in the following exemplary manner. First, and in cooperation with the path module 140, the number of transmitter and receiver latency paths (N) is determined. The parameter determination module 130 then analyses one or more parameters such as data rate, transmitter data rate, receiver data rate, impulse noise protection, bit error rate, latency, or the like. Based on one or more of these parameters, the allocation module 150 allocates a portion of the shared memory 120 to one or more of the interleaver and/or deinterleavers, or groupings thereof. This process continues until the memory allocation has been determined and assigned to each of the N latency paths.

[0046] Having determined the memory allocation for each of the latency paths, and in conjunction with the shared resource management 160, the transceiver 100 transmits to a second transceiver one or more of the number of latency paths (N), the maximum interleaver memory for any one or more of the latency paths and/or the maximum total and/or shared memory for all of the latency paths.

[0047] Three examples of sharing interleaver/deinterleaver memory and coding processing in a transceiver are described below. The latency paths in these examples can be in the transmitter portion of the transceiver or the receiver portion of the transceiver.

[0048] Example #1

A first transmitter portion or receiver portion latency path may carry data from a video application, which needs a very low BER but can tolerate higher latency. In this case, the video will be transported using an latency path that has a large amount of interleaving/deinterleaving and coding (also known as Forward Error Correction (FEC) coding). For example, the latency path may be configured with Reed-Solomon coding using a codeword size of 255 bytes ( $N=255$ ) with 16 checkbytes ( $R=16$ ) and interleaving/deinterleaving using an interleaver depth of 64 ( $D=64$ ). This latency path will require  $N \cdot D = 16 \cdot 255 = 16\text{Kbytes}$  of interleaver memory at the transmitter (or de-interleaver memory at the receiver). This latency path will be able to correct a burst of errors that is less than 512 bytes in duration.

[0049] A second transmitter portion or receiver portion latency path may carry an

internet access application that requires a medium BER and a medium amount of latency. In this case, the internet access application will be transported using a latency path that has a medium amount of interleaving and coding. For example, the latency path may be configured with Reed-Solomon coding using a codeword size of 128 bytes ( $N=128$ ) with 8 checkbytes ( $R=8$ ) and interleaving using an interleaver depth of 16 ( $D=32$ ). This latency path will require  $N*D=128*32=4$ Kbytes of interleaver memory and the same amount of deinterleaver memory. This latency path will be able to correct a burst of errors that is less than 128 bytes in duration.

[0050] A third transmitter portion or receiver portion latency path may carry a voice telephony application, which needs a very low latency but can tolerate BER. In this case, the video will be transported using an latency path that has a large amount of interleaving and coding. For example, the third transmitter portion or receiver portion latency path may be configured with no interleaving or coding which will result in the lowest possible latency through the latency path but will provide no error correction capability.

[0051] According to the principles of this invention, a system carrying the three applications described above in Example #1, would have three latency paths that share one memory space containing at least  $(16+4)=20$  Kbytes. The three latency paths also share a common coding block that is able to simultaneously encode (in the transmitter portion) or decode (in a receiver portion) two codewords with  $N=255/R=16$  and  $N=128/R=8$ .



[0052] According to an exemplary embodiment of this invention, the latency paths can be reconfigured at initialization or during data transmission mode (also known as SHOWTIME in ADSL and VDSL transceivers). This would occur if, for example, the applications or application requirements were to change.

[0053] Example #2

If instead of 1 video application, 1 internet application and 1 voice application, there were 3 internet access applications then the transmitter portion and/or receiver portion latency paths would be reconfigured to utilize the shared memory and coding module in a different way. For example, the system could be reconfigured to have 3 transmitter portion or receiver portion latency paths, with each latency path being configured with Reed-Solomon coding using a codeword size of 128 bytes ( $N=128$ ) with 8 checkbytes ( $R=8$ ) and interleaving using an interleaver depth of 16 ( $D=32$ ). Each latency path will require  $N \cdot D = 128 \cdot 32 = 4\text{Kbytes}$  of interleaver memory and each block will be able to correct a burst of errors that is less than 128 bytes in duration. Based on the example of carrying the three internet access applications described, the three latency path share one memory space containing at least  $3 \cdot 4 = 12\text{ Kbytes}$ . Also the three latency paths share a common coding block that is able to simultaneously encode (on the transmitter side) or decode (on the receiver side) three codewords with  $N=128/R=16$ ,  $N=128/R=8$  and  $N=128/R=8$ .

[0054] Example #3

The system could be configured to carry yet another set of applications. For example, the latency paths could be configured to carry 2 video applications. In this case only

2 transmitter portion or receiver portion latency paths are needed, which means that the third latency path could be simply disabled. Also, assuming that the memory is constrained based on the first example above, then the maximum shared memory for these 2 latency paths is 20 kBytes. In this case, the system could be reconfigured to have 2 latency paths, with each block being configured with Reed-Solomon coding using a codeword size of 200 bytes ( $N=200$ ) with 10 checkbytes ( $R=10$ ) and interleaving/deinterleaving using an interleaver depth of 50 ( $D=50$ ). Each latency path will require  $N*D=200*50=10\text{Kbytes}$  of interleaver memory and each block will be able to correct a burst of errors that is less than 250 bytes in duration. This configuration results in 20K of shared memory for both latency paths, which is the same as in the first example. In order to stay within the memory constraints of the latency paths, the error correction capability for each latency path is decreased to 250 bytes from 512 bytes in Example #1.

[0055] Another aspect of this invention is the how FCI configuration information is transmitted between a first modem and a second modem. FCI configuration information will depend on the requirements of the applications being transported over the DSL connection. This information may need to be forwarded during initialization in order to initially configure the DSL connection. This information may also need to be forwarded during SHOWTIME in order to reconfigure the DSL connection based on a change in applications or the application requirements.

[0056] According to one embodiment, a first modem determines the specific FCI configuration parameters, e.g.,  $N$ ,  $D$ ,  $R$  as defined above, needed to meet specific

application requirements, such as latency, burst error correction capability, etc. In order to determine the FCI configuration parameters, the first modem must know what are the capabilities of a second modem. For example, the first modem must know how many latency paths (FCI blocks) the second modem can support. Also the first modem must know the maximum amount of interleaver memory for each transmitter latency path. In addition, since the transmitter latency paths may share a common memory space the first modem must know the total shared memory for all transmitter latency paths. This way the first modem will be able to choose a configuration that can meet application requirements and also meet the transmitter portion latency path capabilities of the second modem.

[0057] For example, using values from examples above, a first transceiver could send a message to a second transceiver during initialization or during SHOWTIME containing the following information:

- Number of supported transmitter and receiver latency paths = 3
- Max Interleaver Memory for latency path #1= 16 Kbytes
- Max Interleaver Memory for latency path #2= 16 Kbytes
- Max Interleaver Memory for latency path #3= 16 Kbytes
- Maximum total/shared memory for all latency paths = 20 kBytes

Based on this information, and the application requirements, the first transceiver would select latency path settings. For example, if the applications are 1 video, 1 internet access and 1 voice application, the first transceiver could configure 3 latency paths as follows:

latency path #1 – Video: N=255, R=16, D=64

latency path #2 – Video: N=128, R=8, D=32

latency path #3 – Video: N=0, R=0, D=1 (no coding or interleaving)

[0058] This would result in a total interleaver memory of 20 kbytes.

[0059] Alternatively, if for example, there are only 2 video applications, the first transceiver could configure 2 latency paths as follows:

latency path #1 – Video: N=200, R=10, D=50

latency path #2 – Video: N=200, R=10, D=50

latency path #3 – Video: N=0, R=0, D=1 (no coding or interleaving)

[0060] This would also result in a total interleaver memory of 20 kbytes.

[0061] Alternatively, the second transceiver can determine the specific FCI configuration parameters, e.g., N, D, R as defined above, needed to meet specific application requirements, such as latency, burst error correction capability, etc. As described above for the first transceiver, in order to determine the FCI configuration parameters, the second transceiver must first know what are the capabilities of the first transceiver. In this case, the first transceiver would send a message to the second transceiver containing the information described above and based on this information and the application requirements the second transceiver would select latency path settings.

[0062] Fig. 2 outlines an exemplary method of allocating shared memory in a transceiver. More specifically, control begins in step S200 and continues to step S210. In step S210, one or more of shared interleaver/deinterleaver memory and/or shared coder/decoder processing resources are allocated to one or more latency paths, in a transceiver. Control then continues to step S220 where the control sequence ends.

[0063] Fig. 3 outlines an exemplary method of exchanging shared resource allocations according to an exemplary embodiment of this invention. In particular, control begins in step S310. In step S310, a maximum amount of shared memory that can be allocated to a specific interleaver or deinterleaver of a plurality of interleavers or deinterleavers in a transceiver is determined. Next, in step S320, the determined maximum amount for one or more of the deinterleavers and/or interleavers is transmitted to another transceiver. Messages containing additional information can also be transmitted to the other transceiver and/or received from the other transceiver. Control then continues to step S330 where the control sequence ends.

[0064] Fig. 4 outlines an exemplary procedure for resource sharing according to an exemplary embodiment of this invention. In particular, control begins in step S400 and continues to step S410. In step S410, the number of latency paths are determined. Then, in step S420, the latency path information (FCI block information) is transmitted to another transceiver. Messages containing additional information can also be transmitted to the other transceiver and/or received from the other transceiver. This information can be used to, for example, assist with the determination of

memory allocation in the transceiver. Moreover, the messages received from the other transceiver could specify what the memory allocation is to be based on, for example, the number of latency paths, memory allocation in the remote transceiver and required applications. Control then continues to step S430.

[0065] In step S430, and for each latency path, the steps in step 440 are performed.

[0066] In step S440, and while monitoring of allocation of resources is being performed, steps 450 and 460 are performed. More specifically, in step S450, one or more parameters associated with the communication system are determined. Then, in step S460, shared resources are allocated based on one or more of the communication parameters. Control then continues to step S470.

[0067] In step S470, the allocation of shared resources is communicated to another transceiver. Next, in step S480, a determination is made as to whether there is a change in communications that would require the adjustment of the shared resource allocation. Examples of changes in communications conditions include a change in applications being transported over the system and/or changes in the channel condition, etc. If adjustments are required, control jumps back to step S410. Otherwise, control jumps to step S490 where the control sequence ends.

[0068] The above-described system can be implemented on wired and/or wireless telecommunications devices, such a modem, a multicarrier modem, a DSL modem, an

ADSL modem, an XDSL modem, a VDSL modem, a linecard, test equipment, a multicarrier transceiver, a wired and/or wireless wide/local area network system, a satellite communication system, a modem equipped with diagnostic capabilities, or the like, or on a separate programmed general purpose computer having a communications device or in conjunction with any of the following communications protocols: CDSL, ADSL2, ADSL2+, VDSL1, VDSL2, HDSL, DSL Lite, IDSL, RADSL, SDSL, UDSL or the like.

[0069] Additionally, the systems, methods and protocols of this invention can be implemented on a special purpose computer, a programmed microprocessor or microcontroller and peripheral integrated circuit element(s), an ASIC or other integrated circuit, a digital signal processor, a hard-wired electronic or logic circuit such as discrete element circuit, a programmable logic device such as PLD, PLA, FPGA, PAL, a modem, a transmitter/receiver, any comparable means, or the like. In general, any device capable of implementing a state machine that is in turn capable of implementing the methodology illustrated herein can be used to implement the various communication methods, protocols and techniques according to this invention.

[0070] Furthermore, the disclosed methods may be readily implemented in software using object or object-oriented software development environments that provide portable source code that can be used on a variety of computer or workstation platforms. Alternatively, the disclosed system may be implemented partially or fully in hardware using standard logic circuits or VLSI design. Whether software or

hardware is used to implement the systems in accordance with this invention is dependent on the speed and/or efficiency requirements of the system, the particular function, and the particular software or hardware systems or microprocessor or microcomputer systems being utilized. The communication systems, methods and protocols illustrated herein can be readily implemented in hardware and/or software using any known or later developed systems or structures, devices and/or software by those of ordinary skill in the applicable art from the functional description provided herein and with a general basic knowledge of the computer and telecommunications arts.

[0071] Moreover, the disclosed methods may be readily implemented in software that can be stored on a storage medium, executed on programmed general-purpose computer with the cooperation of a controller and memory, a special purpose computer, a microprocessor, or the like. In these instances, the systems and methods of this invention can be implemented as program embedded on personal computer such as an applet, JAVA® or CGI script, as a resource residing on a server or computer workstation, as a routine embedded in a dedicated communication system or system component, or the like. The system can also be implemented by physically incorporating the system and/or method into a software and/or hardware system, such as the hardware and software systems of a communications transceiver.

[0072] It is therefore apparent that there has been provided, in accordance with the present invention, systems and methods for sharing resources. While this invention has been described in conjunction with a number of embodiments, it is



evident that many alternatives, modifications and variations would be or are apparent to those of ordinary skill in the applicable arts. Accordingly, it is intended to embrace all such alternatives, modifications, equivalents and variations that are within the spirit and scope of this invention.

## Claims:

1. A method for sharing resources in a transceiver comprising:  
allocating a first portion of shared memory to a first latency path and  
allocating a second portion of the shared memory to a second latency path.
2. The method of claim 1, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.
3. The method of claim 1, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.
4. The method of claim 1, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.
5. The method of claim 1, further comprising transmitting to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.
6. The method of claim 1, further comprising receiving from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.
7. The method of claim 1, further comprising allocating a shared processing module to a plurality of coding and/or decoding modules.
8. The method of claim 1, wherein the allocating of at least one portion of the shared memory is based on one or more communication parameters.
9. The method of claim 8, wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (BER).

10. A transceiver comprising:  
a first portion of shared memory that is allocated to a first latency path;  
and  
a second portion of the shared memory that is allocated to a second latency path.
11. The transceiver of claim 10, further comprising:  
an allocation module designed to allocate the shared memory based on one or more communication parameters.
12. The transceiver of claim 11, wherein at least one of the communication parameters is a data rate, a latency, an INP value or a Bit Error Rate (BER).
13. The transceiver of claim 10, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.
14. The transceiver of claim 10, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.
15. The transceiver of claim 10, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.
16. The transceiver of claim 10, further comprising a shared resource management module designed to determine information that is transmitted to another transceiver, wherein the information is used to determine a maximum amount of shared memory that can be allocated.
17. The transceiver of claim 10, further comprising a shared resource management module designed to utilize information that is received from another transceiver, wherein the information is used to determine a maximum amount of shared memory that can be allocated.

18. The transceiver of claim 10, further comprising a shared processing module designed to provide processing resources to a plurality of coding and/or decoding modules.

19. A system for sharing resources in a transceiver comprising:  
means for allocating a first portion of shared memory to a first latency path and means for allocating a second portion of the shared memory to a second latency path.

20. The system of claim 19, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.

21. The system of claim 19, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.

22. The system of claim 19, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.

23. The system of claim 19, further comprising means for transmitting to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

24. The system of claim 19, further comprising means for receiving from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

25. The system of claim 19, further comprising means for allocating a shared processing module to a plurality of coding and/or decoding modules.

26. The system of claim 19, wherein the allocating of at least one portion

of the shared memory is based on one or more communication parameters.

27. The system of claim 26, wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (BER).

28. A protocol for sharing resources in a transceiver comprising:  
allocating a first portion of shared memory to a first latency path and  
allocating a second portion of the shared memory to a second latency path.

29. The protocol of claim 28, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.

30. The protocol of claim 28, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.

31. The protocol of claim 28, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.

32. The protocol of claim 28, further comprising transmitting to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

33. The protocol of claim 28, further comprising receiving from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

34. The protocol of claim 28, further comprising allocating a shared processing module to a plurality of coding and/or decoding modules.

35. The protocol of claim 28, wherein the allocating of at least one portion of the shared memory is based on one or more communication parameters.

36. The protocol of claim 35, wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (BER).

37. An information storage media having stored thereon information that when executed allows sharing of resources in a transceiver comprising:  
information that allocates a first portion of shared memory to a first latency path and information that allocates a second portion of the shared memory to a second latency path.

38. The media of claim 37, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.

39. The media of claim 37, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.

40. The media of claim 37, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.

41. The media of claim 37, further comprising information that transmits to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

42. The media of claim 37, further comprising information that receives from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

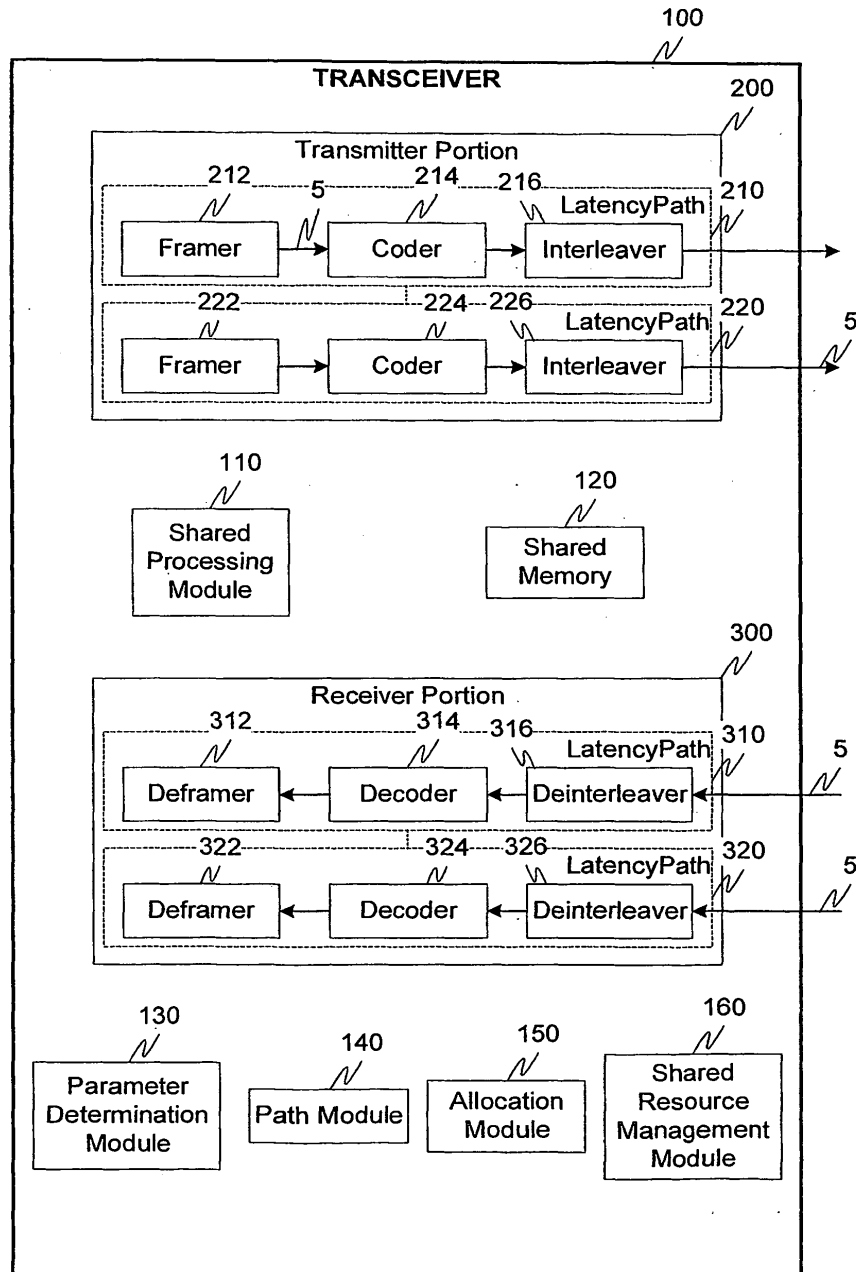
43. The media of claim 37, further comprising information that allocates a shared processing module to a plurality of coding and/or decoding modules.

44. The media of claim 37, wherein the allocating of at least one portion of

the shared memory is based on one or more communication parameters.

45. The media of claim 44, wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (BER).

1/3





2/3

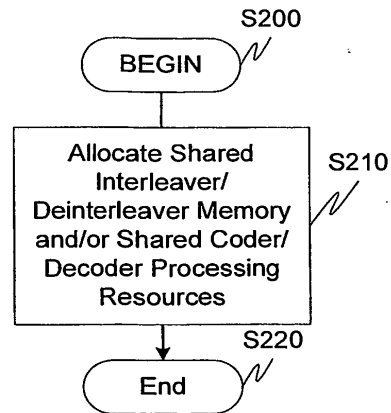


Fig. 2

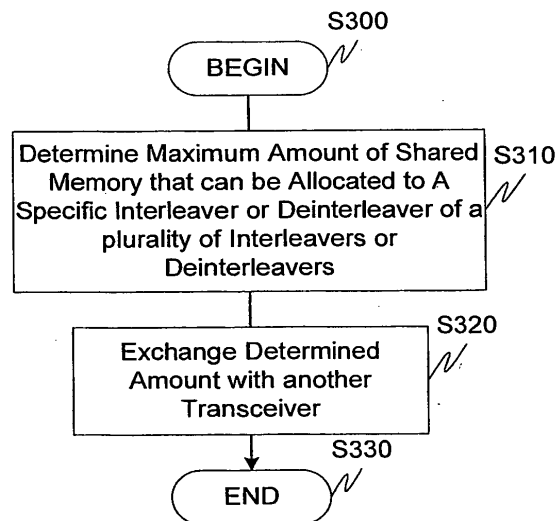


Fig. 3

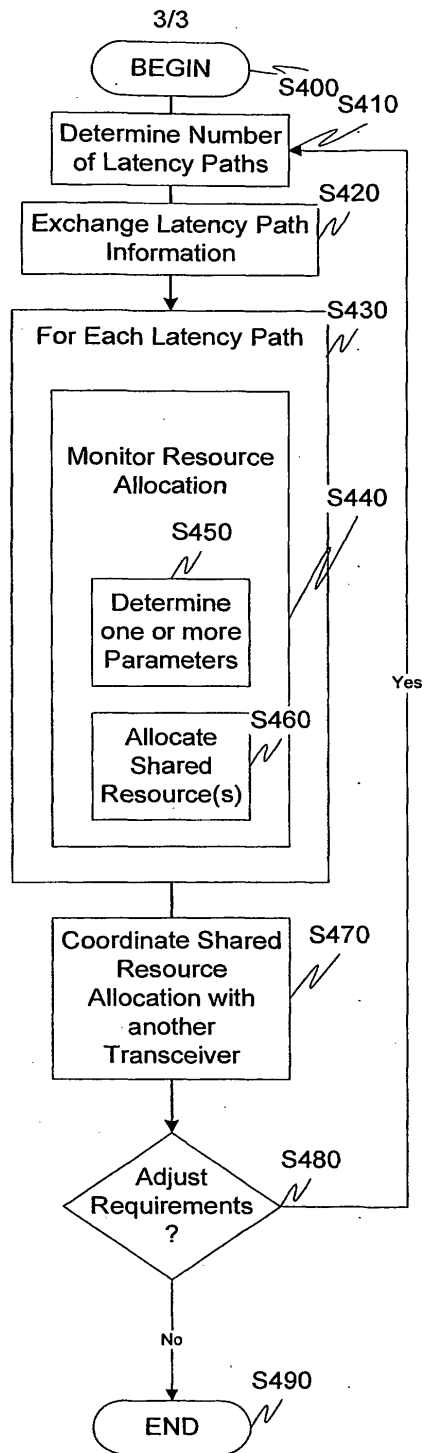


Fig. 4



*ZEN#*

Attorney Docket No. T3653-9285US01

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Patent Application of:

First Named Inventor: TZANNES, MARCOS C.

Art Unit: 2186

Appln. No.: 11/246,163

Examiner:

Filed: October 11, 2005

Confirmation No.: 5478

For: SHARING MEMORY AND PROCESSING  
RESOURCES IN DSL SYSTEMS

\* \* \*

**REPLY TO NOTICE TO FILE MISSING PARTS**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

In response to the Notice to File Missing Parts of Non-Provisional Application under 37 CFR 1.53(b) dated November 8, 2005, submitted herewith are the following items:

- Executed Declaration in compliance with 37 CFR 1.63; Executed Power of Attorney;
- Copy of Notice to File Missing Parts of Non-Provisional Application;
- Assignment and Assignment Recordation Transmittal;
- Checks in the amounts of \$130 and \$80

The Commissioner is hereby authorized to charge to Deposit Account No. 50-1165 (T3653-9285US01) any fees under 37 C.F.R. §§ 1.16 and 1.17 that may be required by this paper and to credit any overpayment to that Account. If any extension of time is required in connection with the filing of this paper and has not been separately requested, such extension is hereby requested.

Respectfully submitted,

By:

*Jason H. Vick*  
Jason H. Vick  
Reg. No. 45,285

Miles & Stockbridge P.C.  
1751 Pinnacle Drive, Suite 500  
McLean, Virginia 22102-3833  
(703) 903-9000  
January 6, 2006  
#9286914  
JHV:jab



UNITED STATES PATENT AND TRADEMARK OFFICE



UNITED STATES DEPARTMENT OF COMMERCE  
 United States Patent and Trademark Office  
 Address: COMMISSIONER FOR PATENTS  
 P.O. Box 1450  
 Alexandria, Virginia 22313-1450  
 www.uspto.gov

| APPLICATION NUMBER | FILING OR 371 (c) DATE | FIRST NAMED APPLICANT | ATTORNEY DOCKET NUMBER |
|--------------------|------------------------|-----------------------|------------------------|
| 11/246,163         | 10/11/2005             | Marcos C. Tzannes     | T3653-9285US01         |

181  
 MILES & STOCKBRIDGE PC  
 1751 PINNACLE DRIVE  
 SUITE 500  
 MCLEAN, VA 22102-3833

**CONFIRMATION NO. 5478**  
**FORMALITIES**  
**LETTER**

Date Mailed: 11/08/2005

## NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

*Filing Date Granted*

### Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The oath or declaration is missing. *A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.*  
*Note: If a petition under 37 CFR 1.47 is being filed, an oath or declaration in compliance with 37 CFR 1.63 signed by all available joint inventors, or if no inventor is available by a party with sufficient proprietary interest, is required.*

The applicant needs to satisfy supplemental fees problems indicated below.

The required item(s) identified below must be timely submitted to avoid abandonment:

- To avoid abandonment, a surcharge (for late submission of filing fee, search fee, examination fee or oath or declaration) as set forth in 37 CFR 1.16(f) of \$130 for a non-small entity, must be submitted with the missing items identified in this letter.

### SUMMARY OF FEES DUE:

Total additional fee(s) required for this application is \$130 for a Large Entity

- \$130 Surcharge.

Replies should be mailed to: Mail Stop Missing Parts

01/09/2006 HALI11 00000068 11246163  
 01 FC:1051 130.00 OP

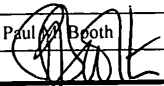
Commissioner for Patents  
P.O. Box 1450  
Alexandria VA 22313-1450

---

*A copy of this notice **MUST** be returned with the reply.*

*SB*

Office of Initial Patent Examination (571) 272-4000, or 1-800-PTO-9199, or 1-800-972-6382  
PART 2 - COPY TO BE RETURNED WITH RESPONSE

| <b>COMBINED FEE TRANSMITTAL</b><br><b>for FY 2005</b><br><i>Effective 12/08/2004. Patent fees are subject to annual revision.</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                       |                                                                                                                 |                 |                       |                 |                       |                | <i>Complete if Known</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------|-----------------|-----------------------|-----------------|-----------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------------------|-----------------|-----------------------|-----------------|------------------------------|--------------------------------------------------------------------------------------------------------------|-----------------------|--------|-------------------------------------|-------|-----------------------------------------------------------------------------------------------------------------|-------|--------------------------------------------------------|-----|--------|-----------------------------------------------|---------------------------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------------------------------------------------|--|--------------|----------------|--------------------------------------------------------|----------------------|--------|--------|-----------------------------------------------------|-----|---------|--------------------|----------------------------------------|-----|---------------------|-----|-----------------------------------------|--|-------------|-----|----------------------------------------|---|-------|-----|-----------------------------------------|--|---------------------|-------|----------------------------------------|--|-----|-----|----------------------------------------|--|----------------------------|-----|-------------------------------------------------------------|--|-------|-------|-----------------------------------------------|--|-----|-----|--------------------------------------------------------|--|-------|-----|------------------------------------------------------------|--|----|----|------------------------------------------------------|--|-----|-----|------------------------------------------------|--|-------|-----|--------------------------|--|-----|-----|----------------------------------------------------------------|--|-----|-----|-----------------------------------------|--|-----|-----|-----------------------------------------------------------|--|---------------------------|--|--|--|-----------------------------|--|--|----------|
| PTO/SB/17 (12-04) (Revised) (For payment of 37 CFR 1.17 fees including (f), (g), (h), and (i))                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                       |                                                                                                                 |                 |                       |                 |                       |                | Application Number: 10/923,592                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| <input checked="" type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                       |                                                                                                                 |                 |                       |                 |                       |                | Filing Date: August 20, 2004                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| <b>TOTAL AMOUNT OF PAYMENT</b> \$ 65.00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                                                                                                                 |                 |                       |                 |                       |                | First Named Inventor: WANG et al.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| <b>METHOD OF PAYMENT (check one)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                       |                                                                                                                 |                 |                       |                 |                       |                | Examiner Name: Unassigned                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| <input checked="" type="checkbox"/> Check <input type="checkbox"/> Credit card <input type="checkbox"/> Money Order <input type="checkbox"/> Other <input type="checkbox"/> None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                       |                                                                                                                 |                 |                       |                 |                       |                | Art Unit: 1626                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| Deposit Account Number: 08-1641                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                       |                                                                                                                 |                 |                       |                 |                       |                | Attorney Docket No.: 40627-0002US1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| Deposit Account Name: Heller Ehrman LLP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                                                                                                                 |                 |                       |                 |                       |                | <b>FEE CALCULATION (continued)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| <b>The Commissioner is authorized to: (check all that apply)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                       |                                                                                                                 |                 |                       |                 |                       |                | <b>4. PETITION FEES UNDER 37 CFR 1.17 (f)</b><br>Fee Code: 1462    Fee \$ 400    For petitions filed under:<br>§ 1.53(e); § 1.57(a); § 1.182; § 1.183; § 1.378(c); § 1.741(b)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| <input type="checkbox"/> Charge fee(s) indicated below                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                       |                                                                                                                 |                 |                       |                 |                       |                | <b>5. PETITION FEES UNDER 37 CFR 1.17 (g)</b><br>Fee Code: 1463    Fee \$ 200    For petitions filed under:<br>§ 1.12; § 1.14; § 1.47; § 1.59; § 1.103(a); § 1.136(b); § 1.295; § 1.296; § 1.377; § 1.550(c); § 1.956; § 5.12; § 5.15; § 5.25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| <input checked="" type="checkbox"/> Credit any overpayments and charge any deficiencies                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                                                                                                                 |                 |                       |                 |                       |                | <b>6. PETITION FEES UNDER 37 CFR 1.17 (h)</b><br>Fee Code: 1464    Fee \$ 130    For petitions filed under:<br>§ 1.19(g); § 1.84; § 1.91; § 1.102(d); § 1.138(c); § 1.313; § 1.314                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| <input type="checkbox"/> Charge any additional fee(s) during the pendency of this application                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                       |                                                                                                                 |                 |                       |                 |                       |                | <b>7. PROCESSING FEES UNDER 37 CFR 1.17 (i)</b><br>Fee Code: 1808 (1803 for § 1.221)    Fee \$ 130    For petitions filed under:<br>§ 1.28(c)(3); § 1.41; § 1.48; § 1.52(d); § 1.53(b)(3); § 1.55; § 1.99(e); § 1.103(b); § 1.103(c); § 1.103(d); § 1.217; § 1.221; § 1.291(c)(5); § 1.497(d); § 3.81                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| <input type="checkbox"/> Charge fee(s) indicated below, except for the filing fee to the deposit account                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                       |                                                                                                                 |                 |                       |                 |                       |                | <b>8. OTHER FEES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| <b>FEE CALCULATION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                       |                                                                                                                 |                 |                       |                 |                       |                | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Entity Fee (\$)</th> <th>Entity Fee (\$)</th> <th>Fee Description</th> <th>Fee Paid</th> </tr> </thead> <tbody> <tr> <td>130</td> <td>65</td> <td>Surcharge - late filing fee or oath</td> <td>65</td> </tr> <tr> <td>50</td> <td>25</td> <td>Surcharge - late provisional filing fee or cover sheet</td> <td></td> </tr> <tr> <td>130</td> <td>130</td> <td>Non-English specification</td> <td></td> </tr> <tr> <td>2,520</td> <td>2,520</td> <td>For filing a request for <i>ex parte</i> reexamination</td> <td></td> </tr> <tr> <td>920*</td> <td>920*</td> <td>Requesting publication of SIR prior to Examiner action</td> <td></td> </tr> <tr> <td>1,840*</td> <td>1,840*</td> <td>Requesting publication of SIR after Examiner action</td> <td></td> </tr> <tr> <td>120</td> <td>60</td> <td>Extension for reply within first month</td> <td></td> </tr> <tr> <td>450</td> <td>225</td> <td>Extension for reply within second month</td> <td></td> </tr> <tr> <td>1,020</td> <td>510</td> <td>Extension for reply within third month</td> <td></td> </tr> <tr> <td>1,590</td> <td>795</td> <td>Extension for reply within fourth month</td> <td></td> </tr> <tr> <td>2,160</td> <td>1,080</td> <td>Extension for reply within fifth month</td> <td></td> </tr> <tr> <td>500</td> <td>250</td> <td>Filing a brief in support of an appeal</td> <td></td> </tr> <tr> <td>790</td> <td>395</td> <td>Filing a submission after final rejection (37 CFR 1.129(a))</td> <td></td> </tr> <tr> <td>1,510</td> <td>1,510</td> <td>Petition to institute a public use proceeding</td> <td></td> </tr> <tr> <td>500</td> <td>250</td> <td>Petition to revive - unavoidably abandoned application</td> <td></td> </tr> <tr> <td>1,500</td> <td>750</td> <td>Petition to revive - unintentionally abandoned application</td> <td></td> </tr> <tr> <td>50</td> <td>50</td> <td>Processing fee for provisional apps (37 CFR 1.17(q))</td> <td></td> </tr> <tr> <td>180</td> <td>180</td> <td>Submission of Information Disclosure Statement</td> <td></td> </tr> <tr> <td>1,000</td> <td>500</td> <td>Request for oral hearing</td> <td></td> </tr> <tr> <td>790</td> <td>395</td> <td>For each additional invention to be examined (37 CFR 1.129(b))</td> <td></td> </tr> <tr> <td>790</td> <td>395</td> <td>Request for Continued Examination (RCE)</td> <td></td> </tr> <tr> <td>900</td> <td>900</td> <td>Request for expedited examination of a design application</td> <td></td> </tr> <tr> <td colspan="4">Other fee (specify) _____</td> </tr> <tr> <td colspan="3" style="text-align: right;"><b>SUBTOTAL (4+5+6+7+8)</b></td> <td>\$ 65.00</td> </tr> </tbody> </table> |                       |                       |                 | Entity Fee (\$)       | Entity Fee (\$) | Fee Description              | Fee Paid                                                                                                     | 130                   | 65     | Surcharge - late filing fee or oath | 65    | 50                                                                                                              | 25    | Surcharge - late provisional filing fee or cover sheet |     | 130    | 130                                           | Non-English specification |       | 2,520                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 2,520 | For filing a request for <i>ex parte</i> reexamination |  | 920*         | 920*           | Requesting publication of SIR prior to Examiner action |                      | 1,840* | 1,840* | Requesting publication of SIR after Examiner action |     | 120     | 60                 | Extension for reply within first month |     | 450                 | 225 | Extension for reply within second month |  | 1,020       | 510 | Extension for reply within third month |   | 1,590 | 795 | Extension for reply within fourth month |  | 2,160               | 1,080 | Extension for reply within fifth month |  | 500 | 250 | Filing a brief in support of an appeal |  | 790                        | 395 | Filing a submission after final rejection (37 CFR 1.129(a)) |  | 1,510 | 1,510 | Petition to institute a public use proceeding |  | 500 | 250 | Petition to revive - unavoidably abandoned application |  | 1,500 | 750 | Petition to revive - unintentionally abandoned application |  | 50 | 50 | Processing fee for provisional apps (37 CFR 1.17(q)) |  | 180 | 180 | Submission of Information Disclosure Statement |  | 1,000 | 500 | Request for oral hearing |  | 790 | 395 | For each additional invention to be examined (37 CFR 1.129(b)) |  | 790 | 395 | Request for Continued Examination (RCE) |  | 900 | 900 | Request for expedited examination of a design application |  | Other fee (specify) _____ |  |  |  | <b>SUBTOTAL (4+5+6+7+8)</b> |  |  | \$ 65.00 |
| Entity Fee (\$)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Entity Fee (\$)       | Fee Description                                                                                                 | Fee Paid        |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 130                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 65                    | Surcharge - late filing fee or oath                                                                             | 65              |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 25                    | Surcharge - late provisional filing fee or cover sheet                                                          |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 130                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 130                   | Non-English specification                                                                                       |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 2,520                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 2,520                 | For filing a request for <i>ex parte</i> reexamination                                                          |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 920*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 920*                  | Requesting publication of SIR prior to Examiner action                                                          |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 1,840*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1,840*                | Requesting publication of SIR after Examiner action                                                             |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 120                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 60                    | Extension for reply within first month                                                                          |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 450                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 225                   | Extension for reply within second month                                                                         |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 1,020                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 510                   | Extension for reply within third month                                                                          |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 1,590                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 795                   | Extension for reply within fourth month                                                                         |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 2,160                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1,080                 | Extension for reply within fifth month                                                                          |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 500                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 250                   | Filing a brief in support of an appeal                                                                          |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 790                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 395                   | Filing a submission after final rejection (37 CFR 1.129(a))                                                     |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 1,510                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1,510                 | Petition to institute a public use proceeding                                                                   |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 500                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 250                   | Petition to revive - unavoidably abandoned application                                                          |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 1,500                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 750                   | Petition to revive - unintentionally abandoned application                                                      |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 50                    | Processing fee for provisional apps (37 CFR 1.17(q))                                                            |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 180                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 180                   | Submission of Information Disclosure Statement                                                                  |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 1,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 500                   | Request for oral hearing                                                                                        |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 790                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 395                   | For each additional invention to be examined (37 CFR 1.129(b))                                                  |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 790                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 395                   | Request for Continued Examination (RCE)                                                                         |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 900                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 900                   | Request for expedited examination of a design application                                                       |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| Other fee (specify) _____                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                       |                                                                                                                 |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| <b>SUBTOTAL (4+5+6+7+8)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                       |                                                                                                                 | \$ 65.00        |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| <b>1. BASIC FILING, SEARCH, AND EXAMINATION FEES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                       |                                                                                                                 |                 |                       |                 |                       |                | * Reduced by Basic Filing Fee Paid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Application Type</th> <th>Entity Fee (\$)</th> <th>Small Entity Fee (\$)</th> <th>Entity Fee (\$)</th> <th>Small Entity Fee (\$)</th> <th>Entity Fee (\$)</th> <th>Small Entity Fee (\$)</th> <th>Fees Paid (\$)</th> </tr> </thead> <tbody> <tr> <td>Utility</td> <td>300</td> <td>150</td> <td>500</td> <td>250</td> <td>200</td> <td>100</td> <td></td> </tr> <tr> <td>Design</td> <td>200</td> <td>100</td> <td>100</td> <td>50</td> <td>135</td> <td>65</td> <td></td> </tr> <tr> <td>Plant</td> <td>200</td> <td>100</td> <td>300</td> <td>150</td> <td>160</td> <td>80</td> <td></td> </tr> <tr> <td>Reissue</td> <td>300</td> <td>150</td> <td>500</td> <td>250</td> <td>600</td> <td>300</td> <td></td> </tr> <tr> <td>Provisional</td> <td>200</td> <td>100</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td></td> </tr> <tr> <td colspan="7" style="text-align: right;"><b>SUBTOTAL (1)</b></td> <td></td> </tr> </tbody> </table> |                       |                                                                                                                 |                 |                       |                 |                       |                | Application Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Entity Fee (\$)       | Small Entity Fee (\$) | Entity Fee (\$) | Small Entity Fee (\$) | Entity Fee (\$) | Small Entity Fee (\$)        | Fees Paid (\$)                                                                                               | Utility               | 300    | 150                                 | 500   | 250                                                                                                             | 200   | 100                                                    |     | Design | 200                                           | 100                       | 100   | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 135   | 65                                                     |  | Plant        | 200            | 100                                                    | 300                  | 150    | 160    | 80                                                  |     | Reissue | 300                | 150                                    | 500 | 250                 | 600 | 300                                     |  | Provisional | 200 | 100                                    | 0 | 0     | 0   | 0                                       |  | <b>SUBTOTAL (1)</b> |       |                                        |  |     |     |                                        |  | <b>2. EXTRA CLAIM FEES</b> |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| Application Type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Entity Fee (\$)       | Small Entity Fee (\$)                                                                                           | Entity Fee (\$) | Small Entity Fee (\$) | Entity Fee (\$) | Small Entity Fee (\$) | Fees Paid (\$) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| Utility                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 300                   | 150                                                                                                             | 500             | 250                   | 200             | 100                   |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| Design                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 200                   | 100                                                                                                             | 100             | 50                    | 135             | 65                    |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| Plant                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 200                   | 100                                                                                                             | 300             | 150                   | 160             | 80                    |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| Reissue                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 300                   | 150                                                                                                             | 500             | 250                   | 600             | 300                   |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| Provisional                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 200                   | 100                                                                                                             | 0               | 0                     | 0               | 0                     |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| <b>SUBTOTAL (1)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                       |                                                                                                                 |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Entity Fee (\$)</th> <th>Small Entity Fee (\$)</th> <th>Fee Description</th> <th>Entity Fee (\$)</th> <th>Small Entity Fee (\$)</th> </tr> </thead> <tbody> <tr> <td>50</td> <td>25</td> <td>Each claim in excess of 20 or, for Reissues, each claim in excess of 20 and more than in the original patent</td> <td>500</td> <td>250</td> </tr> <tr> <td>200</td> <td>100</td> <td>Each independent claim in excess of 3 or, for Reissues, each independent claim more than in the original patent</td> <td>790</td> <td>395</td> </tr> <tr> <td>360</td> <td>180</td> <td>Multiple dependent claim, if not already paid</td> <td>1,510</td> <td>1,510</td> </tr> </tbody> </table>                                                                                                                                                                                                                                                                |                       |                                                                                                                 |                 |                       |                 |                       |                | Entity Fee (\$)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Small Entity Fee (\$) | Fee Description       | Entity Fee (\$) | Small Entity Fee (\$) | 50              | 25                           | Each claim in excess of 20 or, for Reissues, each claim in excess of 20 and more than in the original patent | 500                   | 250    | 200                                 | 100   | Each independent claim in excess of 3 or, for Reissues, each independent claim more than in the original patent | 790   | 395                                                    | 360 | 180    | Multiple dependent claim, if not already paid | 1,510                     | 1,510 | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Extra Claims</th> <th>Fee from above</th> <th>Fee Paid</th> </tr> </thead> <tbody> <tr> <td>Total Claims: 20** =</td> <td>25</td> <td></td> </tr> <tr> <td>Independent Claims: 3** =</td> <td>100</td> <td></td> </tr> <tr> <td>Multiple Dependent</td> <td>180</td> <td></td> </tr> <tr> <td colspan="2" style="text-align: right;"><b>SUBTOTAL (2)</b></td> <td>\$</td> </tr> </tbody> </table> |       |                                                        |  | Extra Claims | Fee from above | Fee Paid                                               | Total Claims: 20** = | 25     |        | Independent Claims: 3** =                           | 100 |         | Multiple Dependent | 180                                    |     | <b>SUBTOTAL (2)</b> |     | \$                                      |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| Entity Fee (\$)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Small Entity Fee (\$) | Fee Description                                                                                                 | Entity Fee (\$) | Small Entity Fee (\$) |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 25                    | Each claim in excess of 20 or, for Reissues, each claim in excess of 20 and more than in the original patent    | 500             | 250                   |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 200                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 100                   | Each independent claim in excess of 3 or, for Reissues, each independent claim more than in the original patent | 790             | 395                   |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| 360                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 180                   | Multiple dependent claim, if not already paid                                                                   | 1,510           | 1,510                 |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| Extra Claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Fee from above        | Fee Paid                                                                                                        |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| Total Claims: 20** =                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 25                    |                                                                                                                 |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| Independent Claims: 3** =                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 100                   |                                                                                                                 |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| Multiple Dependent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 180                   |                                                                                                                 |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| <b>SUBTOTAL (2)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                       | \$                                                                                                              |                 |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| <b>3. APPLICATION SIZE FEE</b><br>If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof (round up to the whole number). See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                       |                                                                                                                 |                 |                       |                 |                       |                | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Total Sheets</th> <th>Extra Sheets</th> <th>Number of each additional 50</th> <th>Fee (\$)</th> <th>Small Entity Fee (\$)</th> </tr> </thead> <tbody> <tr> <td>-100 =</td> <td>/50 =</td> <td>x 250</td> <td>OR</td> <td>x 125</td> </tr> <tr> <td colspan="3" style="text-align: right;"><b>SUBTOTAL (3)</b></td> <td>\$</td> <td></td> </tr> </tbody> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                       |                       |                 | Total Sheets          | Extra Sheets    | Number of each additional 50 | Fee (\$)                                                                                                     | Small Entity Fee (\$) | -100 = | /50 =                               | x 250 | OR                                                                                                              | x 125 | <b>SUBTOTAL (3)</b>                                    |     |        | \$                                            |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| Total Sheets                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Extra Sheets          | Number of each additional 50                                                                                    | Fee (\$)        | Small Entity Fee (\$) |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| -100 =                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | /50 =                 | x 250                                                                                                           | OR              | x 125                 |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| <b>SUBTOTAL (3)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                       |                                                                                                                 | \$              |                       |                 |                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| <b>SUBMITTED BY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                       |                                                                                                                 |                 |                       |                 |                       |                | <b>Complete (if applicable)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| Name (Print/Type): Paul M. Booth                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                       |                                                                                                                 |                 |                       |                 |                       |                | Registration No. (Attorney/Agent): 40,244                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| Signature:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                       |                                                                                                                 |                 |                       |                 |                       |                | Date: January 6, 2006                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |
| Telephone: 202-912-2000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                       |                                                                                                                 |                 |                       |                 |                       |                | Customer No.: 26633                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                       |                       |                 |                       |                 |                              |                                                                                                              |                       |        |                                     |       |                                                                                                                 |       |                                                        |     |        |                                               |                           |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                        |  |              |                |                                                        |                      |        |        |                                                     |     |         |                    |                                        |     |                     |     |                                         |  |             |     |                                        |   |       |     |                                         |  |                     |       |                                        |  |     |     |                                        |  |                            |     |                                                             |  |       |       |                                               |  |     |     |                                                        |  |       |     |                                                            |  |    |    |                                                      |  |     |     |                                                |  |       |     |                          |  |     |     |                                                                |  |     |     |                                         |  |     |     |                                                           |  |                           |  |  |  |                             |  |  |          |

Please type a plus sign (+) inside this box → ☐

PTO/SB/21 (08-00)

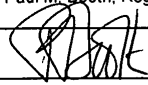
Approved for use through 10/31/2002. OMB 0651-0031

U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

|                                                                                                           |                               |                 |
|-----------------------------------------------------------------------------------------------------------|-------------------------------|-----------------|
| <b>TRANSMITTAL FORM</b><br>(to be used for all correspondence after initial filing)<br><b>JAN 06 2006</b> | <b>Application Number</b>     | 10/923,592      |
|                                                                                                           | <b>Filing Date</b>            | August 20, 2004 |
|                                                                                                           | <b>First Named Inventor</b>   | WANG et al.     |
|                                                                                                           | <b>Group Art Unit</b>         | 1626            |
|                                                                                                           | <b>Examiner Name</b>          | Unassigned      |
| <b>Total Number of Pages in This Submission</b>                                                           | <b>Attorney Docket Number</b> | 40627-0002US1   |

| ENCLOSURES (check all that apply)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Fee Transmittal Form<br><input checked="" type="checkbox"/> Fee Attached<br><input type="checkbox"/> Amendment / Response<br><input type="checkbox"/> After Final<br><input type="checkbox"/> Affidavits/declaration(s)<br><input type="checkbox"/> Extension of Time Request<br><input type="checkbox"/> Express Abandonment Request<br><input type="checkbox"/> Information Disclosure Statement<br><input type="checkbox"/> Certified Copy of Priority Document(s)<br><input type="checkbox"/> Response to Missing Parts/Incomplete Application<br><input type="checkbox"/> Response to Missing Parts under 37 CFR 1.52 or 1.53 | <input type="checkbox"/> Assignment Papers (for an Application)<br><input type="checkbox"/> Drawing(s)<br><input type="checkbox"/> Licensing-related Papers<br><input type="checkbox"/> Petition<br><input type="checkbox"/> Petition to Convert to a Provisional Application<br><input type="checkbox"/> Power of Attorney, Revocation Change of Correspondence Address<br><input type="checkbox"/> Terminal Disclaimer<br><input type="checkbox"/> Request for Refund<br><input type="checkbox"/> CD, Number of CD(s) _____ | <input type="checkbox"/> After Allowance Communication to Group<br><input type="checkbox"/> Appeal Communication to Board of Appeals and Interferences<br><input type="checkbox"/> Appeal Communication to Group (Appeal Notice, Brief, Reply Brief)<br><input type="checkbox"/> Proprietary Information<br><input type="checkbox"/> Status Letter<br><input checked="" type="checkbox"/> Other Enclosure(s) (please identify below):<br><b>Response to Missing Parts of Nonprovisional Application</b> |
| <b>Remarks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

| SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT |                                                                                     |
|--------------------------------------------|-------------------------------------------------------------------------------------|
| Firm or Individual name                    | Paul M. Booth, Reg. No. 40,244, Customer No. 26633                                  |
| Signature                                  |  |
| Date                                       | January 6, 2006                                                                     |

| CERTIFICATE OF MAILING                                                                                                                                                                                                             |       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231 on this date: _____ |       |
| Typed or printed name                                                                                                                                                                                                              | _____ |
| Signature                                                                                                                                                                                                                          | _____ |
| Date                                                                                                                                                                                                                               | _____ |

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.



Attorney Docket No. 40627-0002US1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s) WANG et al. Confirmation No.: 4888  
Appl. No.: 10/923,592 Group Art Unit: 1626  
Filing Date: August 20, 2004 Examiner: Unassigned  
Title: SUBSTITUTED 8-HETEROARYL XANTHINES

**RESPONSE TO NOTICE TO FILE MISSING PARTS**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

This communication responds to the Notice to File Missing Parts mailed October 19, 2004, in the above-captioned application. Applicants submitted the required Declaration and Power of Attorney, in a timely fashion, in response to the Notice on December 4, 2004, paying the \$65.00 filing fee under small entity status. Applicants have since been informed that this application no longer qualifies for small entity status. Thus, Applicants submit herewith an addition filing fee of \$65.00 under 37 CFR 1.27 for large entity.

Applicants believe the appropriate fees are attached, however, the Commissioner is hereby authorized to charge any deficiency or to credit any overpayment to Deposit Account No. 08-1641.

Respectfully submitted,

Date: January 6, 2006

HELLER EHRMAN LLP  
1717 Rhode Island Avenue, NW  
Washington, D.C. 20036  
Phone: 202-912-2000  
Fax: 202-912-2020

Paul M. Booth  
Reg. No. 40,244  
Attorney for Applicant

Customer No. 26633

01/09/2006 HALI11 00000086 10923592

01 FC:2051

65.00 DP





001/003

Approved for use through 07/31/2006 OMB 0651-0032  
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE  
Under the Paperwork Reduction Act of 1995, no person are required to respond to a collection of information unless it displays a valid OMB control number.  
Docket No. T3653-9285US01

**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN  
APPLICATION DATA SHEET (37 CFR 1.76)**

Title of  
Invention

**RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT**

As the below named inventor(s), I/we declare that:

This declaration is directed to:

- ☐ The attached application, or  
☒ Application No. 11/246,163, filed on October 11, 2005  
☐ as amended on \_\_\_\_\_ (if applicable):

I/we believe that I/we am/are the original and first inventor(s) of the subject matter which is claimed and for which a patent is sought;

I/we have reviewed and understand the contents of the above-identified application, including the claims, as amended by any amendment specifically referred to above;

I/we acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me/us to be material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT International filing date of the continuation-in-part application.

All statements made herein of my/own knowledge are true, all statements made herein on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001, and may jeopardize the validity of the application or any patent issuing thereon.

**FULL NAME OF INVENTOR(S)**

Inventor one: Marcos C. TZANNES

Signature: [Signature] Citizen of: U.S.A.

Inventor two: Michael LUND

Signature: [Signature] Citizen of: U.S.A.

Inventor three: \_\_\_\_\_

Signature: \_\_\_\_\_ Citizen of: \_\_\_\_\_

Inventor four: \_\_\_\_\_

Signature: \_\_\_\_\_ Citizen of: \_\_\_\_\_

☐ Additional inventors or a legal representative are being named on \_\_\_\_\_ additional form(s) attached hereto.

This collection of information is required by 37 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

AGE 2/5 \* RCVD AT 1/5/2006 11:05:03 AM [Eastern Standard Time] \* SVR:TYSOFAJ0 \* DNIS:9994 \* CSID:17816870430 \* DURATION (mm:ss):02:14



Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PTO/SB/81 (11-04)  
Approved for use through 01/30/2005 OMB 0651-0035  
U.S. Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

**POWER OF ATTORNEY  
and  
CORRESPONDENCE ADDRESS  
INDICATION FORM**

|                        |                                                            |
|------------------------|------------------------------------------------------------|
| Application Number     |                                                            |
| Filing Date            |                                                            |
| First Named Inventor   | Marcos C. TZANNES                                          |
| Title                  | RESOURCE SHARING IN A<br>TELECOMMUNICATIONS<br>ENVIRONMENT |
| Art Unit               |                                                            |
| Examiner Name          |                                                            |
| Attorney Docket Number | T3653-9285US01                                             |

I hereby revoke all previous powers of attorney given in the above-identified application.

I hereby appoint:

☒ Practitioners associated with the Customer Number:

000181

OR

☐ Practitioner(s) named below:

| Name | Registration Number |
|------|---------------------|
|      |                     |

as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith.

Please recognize or change the correspondence address for the above-identified application to:

☒ The address associated with the above-mentioned Customer Number:

OR

☐ The address associated with Customer Number:

|                                                  |       |     |  |  |
|--------------------------------------------------|-------|-----|--|--|
| <input type="checkbox"/> Firm or Individual Name |       |     |  |  |
| Address                                          |       |     |  |  |
| City                                             | State | Zip |  |  |
| Country                                          |       |     |  |  |
| Telephone                                        | Fax   |     |  |  |

I am the:

☒ Applicant/Inventor.

☐ Assignee of record of the entire interest. See CFR 3.71.  
Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96).

**SIGNATURE of Applicant or Assignee of Record**

|                   |              |           |                   |
|-------------------|--------------|-----------|-------------------|
| Signature         |              | Date      | November 29, 2005 |
| Name              | Michael LUND | Telephone |                   |
| Title and Company |              |           |                   |

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below\*.

☒ \*Total of 2 forms are submitted.

This collection of information is required by 37 CFR 1.32, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.



002/003

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Approved for use through 01/30/2005 OMB 0551-0035  
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

|                                                                                 |                        |                                                            |
|---------------------------------------------------------------------------------|------------------------|------------------------------------------------------------|
| <b>POWER OF ATTORNEY<br/>and<br/>CORRESPONDENCE ADDRESS<br/>INDICATION FORM</b> | Application Number     |                                                            |
|                                                                                 | Filing Date            |                                                            |
|                                                                                 | First Named Inventor   | Marcos C. TZANNES                                          |
|                                                                                 | Title                  | RESOURCE SHARING IN A<br>TELECOMMUNICATIONS<br>ENVIRONMENT |
|                                                                                 | Art Unit               |                                                            |
|                                                                                 | Examiner Name          |                                                            |
|                                                                                 | Attorney Docket Number | T3653-9285US01                                             |

I hereby revoke all previous powers of attorney given in the above-identified application.

I hereby appoint:

☒ Practitioners associated with the Customer Number:

000181

OR

|      |                     |
|------|---------------------|
| Name | Registration Number |
|      |                     |

as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith.

Please recognize or change the correspondence address for the above-identified application to:

☒ The address associated with the above-mentioned Customer Number:

OR

☐ The address associated with Customer Number:

OR

☐ Firm or  
Individual Name

Address

City

State

Zip

Country

Telephone

Fax

I am the:

☒ Applicant/Inventor.

☐ Assignee of record of the entire interest. See CFR 3.71.

Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96).

**SIGNATURE of Applicant or Assignee of Record**

|                   |                   |           |                   |
|-------------------|-------------------|-----------|-------------------|
| Signature         |                   | Date      | November 29, 2005 |
| Name              | Marcos C. TZANNES | Telephone |                   |
| Title and Company |                   |           |                   |

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below.

☒ \*Total of 2 form is submitted.

This collection of information is required by 37 CFR 1.32, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

| APPLICATION NUMBER | FILING OR 371 (c) DATE | FIRST NAMED APPLICANT | ATTORNEY DOCKET NUMBER |
|--------------------|------------------------|-----------------------|------------------------|
| 11/246,163         | 10/11/2005             | Marcos C. Tzannes     | T3653-9285US01         |

181  
MILES & STOCKBRIDGE PC  
1751 PINNACLE DRIVE  
SUITE 500  
MCLEAN, VA 22102-3833

**CONFIRMATION NO. 5478**  
**FORMALITIES**  
**LETTER**

Date Mailed: 11/08/2005

**NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION**

**FILED UNDER 37 CFR 1.53(b)**

***Filing Date Granted***

**Items Required To Avoid Abandonment:**

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The oath or declaration is missing. *A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required. Note: If a petition under 37 CFR 1.47 is being filed, an oath or declaration in compliance with 37 CFR 1.63 signed by all available joint inventors, or if no inventor is available by a party with sufficient proprietary interest, is required.*

The applicant needs to satisfy supplemental fees problems indicated below.

The required item(s) identified below must be timely submitted to avoid abandonment:

- To avoid abandonment, a surcharge (for late submission of filing fee, search fee, examination fee or oath or declaration) as set forth in 37 CFR 1.16(f) of \$130 for a non-small entity, must be submitted with the missing items identified in this letter.

**SUMMARY OF FEES DUE:**

Total additional fee(s) required for this application is **\$130** for a Large Entity

- **\$130** Surcharge.

Replies should be mailed to: Mail Stop Missing Parts

Commissioner for Patents  
P.O. Box 1450  
Alexandria VA 22313-1450

---

*A copy of this notice **MUST** be returned with the reply.*

  
Office of Initial Patent Examination (571) 272-4000, or 1-800-PTO-9199, or 1-800-972-6382  
PART 3 - OFFICE COPY

13281 U.S. PTO  
101105

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PTO/SB/0:  
Approved for use through 07/31/2006 OMB 0:  
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COM

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>UTILITY<br/>PATENT APPLICATION<br/>TRANSMITTAL</b><br>(Only for new nonprovisional applications under 37 CFR 1.53(b))                                                                                                                                                                                                                                                                                                                                                                                        |                                   | Attorney Docket No.<br><b>T3653-9285US01</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                   | First Named Inventor<br><b>TZANNES, MARCOS C.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                   | Title<br><b>SHARING MEMORY AND<br/>PROCESSING RESOURCE<br/>DSL SYSTEMS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                   | Express Mail Label No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>APPLICATION ELEMENTS</b><br>See MPEP chapter 600 concerning utility patent application contents.                                                                                                                                                                                                                                                                                                                                                                                                             |                                   | ADDRESS TO: Commissioner for Patents<br>P.O. Box 1450<br>Alexandria, VA 22313-1450                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 1. <input checked="" type="checkbox"/> <b>Fee Transmittal Form</b> (e.g., PTO/SB/17)<br>(Submit an original and a duplicate for fee processing)                                                                                                                                                                                                                                                                                                                                                                 |                                   | <b>ACCOMPANYING APPLICATION PARTS</b><br>9. <input type="checkbox"/> <b>Assignment Papers</b> (cover sheet & document(s))<br>Name of Assignee _____<br>10. <input type="checkbox"/> <b>37 CFR 3.73(b) Statement</b> <input type="checkbox"/> <b>Power of Attorney</b><br>(when there is an assignee)<br>11. <input type="checkbox"/> <b>English Translation Document</b> (if applicable)<br>12. <input type="checkbox"/> <b>Information Disclosure Statement</b> (PTO/SB/08 or PTO-1449)<br><input type="checkbox"/> Copies of citations enclosed<br>13. <input type="checkbox"/> <b>Preliminary Amendment</b><br>14. <input checked="" type="checkbox"/> <b>Return Receipt Postcard</b> (MPEP 503)<br>(Should be specifically itemized)<br>15. <input type="checkbox"/> <b>Certified Copy of Priority Document(s)</b><br>(if foreign priority is claimed)<br>16. <input type="checkbox"/> <b>Nonpublication Request</b> under 35 U.S.C. 122(b)(2)(B)(i).<br>Applicant must attach form PTO/SB/35 or equivalent<br>17. <input type="checkbox"/> <b>Other:</b> _____ |
| 2. <input type="checkbox"/> <b>Applicant claims small entity status</b><br>See 37 CFR 1.27                                                                                                                                                                                                                                                                                                                                                                                                                      |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 3. <input checked="" type="checkbox"/> <b>Specification</b> [Total Pages 30]<br>Both the claims and abstract must start on a new page<br>(For information on the preferred arrangement, see MPEP 608.01(a))                                                                                                                                                                                                                                                                                                     |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 4. <input checked="" type="checkbox"/> <b>Drawing(s)</b> (35 U.S.C. 113) [Total Sheets 3]                                                                                                                                                                                                                                                                                                                                                                                                                       |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 5. <b>Oath or Declaration</b> [Total Sheets _____]<br>a. <input type="checkbox"/> Newly executed (original or copy)<br>b. <input type="checkbox"/> Unexecuted (original or copy)<br>c. <input type="checkbox"/> A copy from a prior application (37 CFR 1.63(d))<br>(for continuation/divisional with Box 18 completed)<br>i. <input type="checkbox"/> <b>DELETION OF INVENTOR(S)</b><br>Signed statement attached deleting inventor(s)<br>named in the prior application, see 37 CFR<br>1.63(d)(2) and 1.33(b) |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 6. <input checked="" type="checkbox"/> <b>Application Data Sheet.</b> See 37 CFR 1.76                                                                                                                                                                                                                                                                                                                                                                                                                           |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 7. <input type="checkbox"/> <b>CD-ROM or CD-R</b> in duplicate, large table or Computer<br>Program (Appendix)<br><input type="checkbox"/> Landscape Table on CD                                                                                                                                                                                                                                                                                                                                                 |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 8. <b>Nucleotide and/or Amino Acid Sequence Submission</b><br>(if applicable, items a.-c. are required)<br>a. <input type="checkbox"/> Computer Readable Form (CRF)<br>b. <input type="checkbox"/> Specification Sequence Listing on:<br>i. <input type="checkbox"/> CD-ROM or CD-R (2 copies; or<br>ii. <input type="checkbox"/> Paper<br>c. <input type="checkbox"/> Statements verifying identity of above copies                                                                                            |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 18. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in the first sentence of the specification following the title, or in an Application Data Sheet under 37 CFR 1.76:<br><input type="checkbox"/> Continuation <input type="checkbox"/> Divisional <input type="checkbox"/> Continuation-in-part (CIP) of prior application No.: 60/618,269<br>Prior application information: Examiner Art Unit:                                                            |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>19. CORRESPONDENCE ADDRESS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <input checked="" type="checkbox"/> The address associated with Customer Number:                                                                                                                                                                                                                                                                                                                                                                                                                                |                                   | or <input type="checkbox"/> Correspondence address below                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 000181                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | City                              | State                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Country                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Telephone                         | Zip Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Signature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Date                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Name (Print/Type)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Registration No. (Attorney/Agent) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of C P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. 1450, Alexandria, VA 22313-1450.



101105  
13281 U.S. PTO

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PTO/SB/0:  
Approved for use through 07/31/2006 OMB 07  
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COM

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>UTILITY<br/>PATENT APPLICATION<br/>TRANSMITTAL</b><br><i>(Only for new nonprovisional applications under 37 CFR 1.53(b))</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                   | Attorney Docket No.<br><b>T3653-9285US01</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                   | First Named Inventor<br><b>TZANNES, MARCOS C.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                   | Title<br><b>SHARING MEMORY AND<br/>PROCESSING RESOURCE<br/>DSL SYSTEMS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                   | Express Mail Label No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>APPLICATION ELEMENTS</b><br>See MPEP chapter 600 concerning utility patent application contents.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                   | ADDRESS TO: Commissioner for Patents<br>P.O. Box 1450<br>Alexandria, VA 22313-1450                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 1. <input checked="" type="checkbox"/> <b>Fee Transmittal Form</b> (e.g., PTO/SB/17)<br><i>(Submit an original and a duplicate for fee processing)</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                   | <b>ACCOMPANYING APPLICATION PARTS</b><br>9. <input type="checkbox"/> <b>Assignment Papers</b> (cover sheet & document(s))<br>Name of Assignee _____<br>10. <input type="checkbox"/> <b>37 CFR 3.73(b) Statement</b> <input type="checkbox"/> <b>Power of Attorney</b><br><i>(when there is an assignee)</i><br>11. <input type="checkbox"/> <b>English Translation Document</b> <i>(if applicable)</i><br>12. <input type="checkbox"/> <b>Information Disclosure Statement</b> (PTO/SB/08 or PTO-1449)<br><input type="checkbox"/> Copies of citations enclosed<br>13. <input type="checkbox"/> <b>Preliminary Amendment</b><br>14. <input checked="" type="checkbox"/> <b>Return Receipt Postcard</b> (MPEP 503)<br><i>(Should be specifically itemized)</i><br>15. <input type="checkbox"/> <b>Certified Copy of Priority Document(s)</b><br><i>(if foreign priority is claimed)</i><br>16. <input type="checkbox"/> <b>Nonpublication Request</b> under 35 U.S.C. 122(b)(2)(B)(i).<br>Applicant must attach form PTO/SB/35 or equivalent<br>17. <input type="checkbox"/> <b>Other:</b> _____ |
| 2. <input type="checkbox"/> <b>Applicant claims small entity status</b><br>See 37 CFR 1.27                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 3. <input checked="" type="checkbox"/> <b>Specification</b> <i>[Total Pages 30]</i><br>Both the claims and abstract must start on a new page<br>(For information on the preferred arrangement, see MPEP 608.01(a))                                                                                                                                                                                                                                                                                                                                                                                                                               |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 4. <input checked="" type="checkbox"/> <b>Drawing(s)</b> (35 U.S.C. 113) <i>[Total Sheets 3]</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 5. <b>Oath or Declaration</b> <i>[Total Sheets _____]</i><br>a. <input type="checkbox"/> Newly executed (original or copy)<br>b. <input type="checkbox"/> Unexecuted (original or copy)<br>c. <input type="checkbox"/> A copy from a prior application (37 CFR 1.63(d))<br><i>(for continuation/divisional with Box 18 completed)</i><br>i. <input type="checkbox"/> <b>DELETION OF INVENTOR(S)</b><br>Signed statement attached deleting inventor(s)<br>named in the prior application, see 37 CFR<br>1.63(d)(2) and 1.33(b)<br>ii. <input type="checkbox"/> Paper<br>c. <input type="checkbox"/> Statements verifying identity of above copies |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 6. <input checked="" type="checkbox"/> <b>Application Data Sheet.</b> See 37 CFR 1.76                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 7. <input type="checkbox"/> <b>CD-ROM or CD-R</b> in duplicate, large table or Computer<br>Program (Appendix)<br><input type="checkbox"/> Landscape Table on CD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 8. <b>Nucleotide and/or Amino Acid Sequence Submission</b><br><i>(if applicable, items a.-c. are required)</i><br>a. <input type="checkbox"/> Computer Readable Form (CRF)<br>b. <input type="checkbox"/> Specification Sequence Listing on:<br>i. <input type="checkbox"/> CD-ROM or CD-R (2 copies; or<br>ii. <input type="checkbox"/> Paper<br>c. <input type="checkbox"/> Statements verifying identity of above copies                                                                                                                                                                                                                      |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 18. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in the first sentence of the specification following the title, or in an Application Data Sheet under 37 CFR 1.76:<br><input type="checkbox"/> Continuation <input type="checkbox"/> Divisional <input type="checkbox"/> Continuation-in-part (CIP) of prior application No.: 60/618,269<br>Prior application information: Examiner Art Unit:                                                                                                                                                                                             |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>19. CORRESPONDENCE ADDRESS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <input checked="" type="checkbox"/> The address associated with Customer Number:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                   | or <input type="checkbox"/> Correspondence address below                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 000181                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | City                              | State                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Country                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Telephone                         | Zip Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                   | Fax                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Signature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Date                              | October 11, 2005                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Name (Print/Type)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Registration No. (Attorney/Agent) | 45,285                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of C P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. 1450, Alexandria, VA 22313-1450.





**RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT**

RELATED APPLICATION DATA

[0001] This application claims the benefit of and priority under 35 U.S.C. § 119(e) to U.S. Patent Application No. 60/618,269, filed October 12, 2004, entitled “Sharing Memory and Processing Resources in DSL Systems,” which is incorporated herein by reference in its entirety.

BACKGROUND

Field of the Invention

[0002] This invention generally relates to communication systems. More specifically, an exemplary embodiment of this invention relates to memory sharing in communication systems. Another exemplary embodiment relates to processing or coding resource sharing in a communication system.

Description of Related Art

[0003] U.S. Patent Nos. 6,775,320 and 6,778,589, which are both incorporated herein by reference in their entirety, describe DSL systems supporting multiple applications and multiple framer/coder/interleaver FCI blocks (an FCI block is also referred to as a latency path). DSL systems carry applications that have different transmission requirements with regard to, for example, data rate, latency (delay), bit error rate (BER), and the like. For example, video typically requires a low BER ( $<1\text{E-}10$ ) but can tolerate higher latency ( $>20$  ms). Voice, on the other hand, typically requires a low latency ( $<1$  ms) but can tolerate BER ( $>1\text{E-}3$ ).

[0004] As described in U.S. Patent No. 6,775,320, different applications can use different latency paths in order to satisfy the different application requirements of the communication system. As a result a transceiver must support multiple latency paths in order to support applications such as video, Internet access and voice telephony. When implemented in a transceiver, each of the latency paths will have a framer, coder, and interleaver block with different capabilities that depend on the application requirements.

#### SUMMARY

[0005] One difficulty with implementing multiple latency paths in a transceiver is the fact that a latency path is a complicated digital circuit that requires a large amount of memory and processing power. An interleaver within a latency path can consume a large amount of memory in order to provide error correcting capability. For example, a typical DSL transceiver will have at least one latency path with approximately 16 kbytes of memory for the interleaver. Likewise, the coding block, for example, a Reed Solomon coder, consumes a large amount of processing power. In general, as the number of latency paths increase, the memory and processing power requirements for a communication system become larger.

[0006] Accordingly, an exemplary aspect of this invention relates to sharing memory between one or more interleavers and/or deinterleavers in a transceiver. More particularly, an exemplary aspect of this invention relates to shared latency path memory in a transceiver.

[0007] Additional aspects of this invention relate to configuring and initializing shared memory in a communication system. More particularly, an exemplary aspect of this invention relates to configuring and initializing interleaver/deinterleaver memory in a communication system.

[0008] Additional aspects of the invention relate to determining the amount of memory that can be allocated to a particular component by a communication system. More specifically, an exemplary aspect of the invention relates to determining the maximum amount of shared memory that can be allocated to one or more interleaves or deinterleavers.

[0009] According to another exemplary aspect of the invention, processing power is shared between a number of transceiver modules. More specifically, and in accordance with an exemplary embodiment of the invention, a coding module is shared between one or more coders and/or decoders.

[0010] Another exemplary embodiment of the invention relates to transitioning from a fixed memory configuration to a shared memory configuration during one or more of initialization and SHOWTIME (user data transmission).

[0011] An additional exemplary aspect of the invention relates to dynamically updating one or more of shared memory and processing resources based on changing communication conditions.

[0012] An additional exemplary aspect of the invention relates to updating one or more of shared memory and processing resources based on an updated communication parameter.

[0013] An additional exemplary aspect of the invention relates to updating the allocation of one or more of shared memory and processing resources based on an updated communication parameter(s).

[0014] Additional aspects of the invention relate to exchanging shared resource allocations between transceivers.

[0015] Additional exemplary aspects relate to a method of allocating shared memory in a transceiver comprising allocating the shared memory to a plurality of modules, wherein each of the plurality of modules comprise at least one interleaver, at least one deinterleaver or a combination thereof.

[0016] Still further aspects relate to the above method wherein the plurality of modules comprise interleavers.

[0017] Still further aspects relate to the above method wherein the plurality of modules comprise deinterleavers.

[0018] Still further aspects relate to the above method wherein the plurality of modules comprise at least one interleaver and at least one deinterleaver.

[0019] Additional exemplary aspects relate to a transceiver comprising a plurality of modules each including at least one interleaver, at least one deinterleaver or a

combination thereof and a shared memory designed to be allocated to a plurality of the modules.

[0020] Still further aspects relate to the above transceiver wherein the plurality of modules comprise interleavers.

[0021] Still further aspects relate to the above transceiver wherein the plurality of modules comprise deinterleavers.

[0022] Still further aspects relate to the above transceiver wherein the plurality of modules comprise at least one interleaver and at least one deinterleaver.

[0023] These and other features and advantages of this invention are described in, or are apparent from, the following description of the embodiments.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The embodiments of the invention will be described in detail, with reference to the following figures, wherein:

[0025] Fig. 1 is a functional block diagram illustrating an exemplary transceiver according to this invention;

[0026] Fig. 2 is a flowchart outlining an exemplary method of sharing resources according to this invention;

[0027] Fig. 3 is a flowchart outlining an exemplary method of determining a maximum amount of shared memory according to this invention; and

[0028] Fig. 4 is a flowchart outlining an exemplary resource sharing methodology according to this invention.

DETAILED DESCRIPTION

[0029] The exemplary embodiments of this invention will be described in relation to sharing resources in a wired and/or wireless communications environment. However, it should be appreciated, that in general, the systems and methods of this invention will work equally well for any type of communication system in any environment.

[0030] The exemplary systems and methods of this invention will also be described in relation to multicarrier modems, such as DSL modems and VDSL modems, and associated communication hardware, software and communication channels. However, to avoid unnecessarily obscuring the present invention, the following description omits well-known structures and devices that may be shown in block diagram form or otherwise summarized.

[0031] For purposes of explanation, numerous details are set forth in order to provide a thorough understanding of the present invention. It should be appreciated however that the present invention may be practiced in a variety of ways beyond the specific details set forth herein.

[0032] Furthermore, while the exemplary embodiments illustrated herein show the various components of the system collocated, it is to be appreciated that the various components of the system can be located at distant portions of a distributed

network, such as a telecommunications network and/or the Internet, or within a dedicated secure, unsecured and/or encrypted system. Thus, it should be appreciated that the components of the system can be combined into one or more devices, such as a modem, or collocated on a particular node of a distributed network, such as a telecommunications network. As will be appreciated from the following description, and for reasons of computational efficiency, the components of the system can be arranged at any location within a distributed network without affecting the operation of the system. For example, the various components can be located in a Central Office modem (CO, ATU-C, VTU-O), a Customer Premises modem (CPE, ATU-R, VTU-R), a DSL management device, or some combination thereof. Similarly, one or more functional portions of the system could be distributed between a modem and an associated computing device.

[0033] Furthermore, it should be appreciated that the various links, including communications channel 5, connecting the elements can be wired or wireless links, or any combination thereof, or any other known or later developed element(s) that is capable of supplying and/or communicating data to and from the connected elements. The term module as used herein can refer to any known or later developed hardware, software, firmware, or combination thereof that is capable of performing the functionality associated with that element. The terms determine, calculate and compute, and variations thereof, as used herein are used interchangeably and include any type of methodology, process, mathematical operation or technique. FCI block and latency path are used interchangeably herein as well as transmitting modem and transmitting transceiver. Receiving modem and receiving transceiver are also used



interchangeably.

[0034] Fig. 1 illustrates an exemplary embodiment of a transceiver 100 that utilizes shared resources. It should be appreciated that numerous functional components of the transceiver have been omitted for clarity. However, the transceiver 100 can also include the standard components found in typical communications device(s) in which the technology of the subject invention is implemented into.

[0035] According to an exemplary embodiment of the invention, memory and processing power can be shared among a plurality of transmitter and/or receiver latency paths, in a communications transceiver that carries or supports multiple applications. For example, the transmitter and/or receiver latency paths of the transceiver can share an interleaver/deinterleaver memory and the shared memory can be allocated to the interleaver and/or deinterleaver of each latency path. This allocation can be done based on the data rate, latency, BER, impulse noise protection requirements of the application, data or information being transported over each latency path, or in general any parameter associated with the communications system.

[0036] Likewise, for example, the transmitter and/or receiver latency paths can share a Reed-Solomon coder/decoder processing module and the processing power of this module can be allocated to each encoder and/or decoder. This allocation can be done based on the data rate/latency, BER, impulse noise protection requirements of the application data or information being transported over each latency path, or in general based on any parameter associated with the communication system.

**[0037]** In accordance with an exemplary operational embodiment, a first transceiver and a second transceiver transmit to one another messages during, for example, initialization which contain information on the total and/or shared memory capabilities of each transceiver and optionally information about the one or more latency paths. This information can be transmitted prior to determining how to configure the latency paths to support the application requirements. Based on this information, one of the modems can select an FCI configuration parameter(s) that meets the transmission requirements of each application being transported over each latency paths. While an exemplary of the embodiment of the invention will be described in relation to the operation of the invention and characteristics thereof being established during initialization, it should be appreciated that the sharing of resources can be modified and messages transmitted between a two transceivers at any time during initialization and/or user data transmission, i.e., SHOWTIME.

**[0038]** Fig. 1 illustrates an exemplary embodiment of a transceiver 100. The transceiver 100 includes a transmitter portion 200 and a receiver portion 300. The transmitter portion 200 includes one or more latency paths 210, 220, .... Similarly, the receiver portion 300 includes one or more latency paths 310, 320, .... Each of the latency paths in the transmitter portion 200 includes a framer, coder, and interleaver designated as 212, 214, 216 and 222, 224 and 226, respectively. Each of the latency paths in the receiver portion includes a deframer, decoder, and deinterleaver designated as 312, 314, 316 and 322, 324, and 326, respectively. The transceiver 100 further includes a shared processing module 110, a shared memory 120, a parameter

determination module 130, a path module 140, an allocation module 150, and a shared resource management module 160, all interconnected by one or more links (not shown).

**[0039]** In this exemplary embodiment, the transceiver 100 is illustrated with four total transmitter portion and receiver portion latency paths, i.e., 210, 220, 310, and 320. The shared memory 120 is shared amongst the two transmitter portion interleavers 216 and 226 and two receiver portion deinterleavers 316 and 326. The shared processing module 110, such as a shared coding module, is shared between the two transmitter portion coders 214 and 224 and the two receiver portion decoders 314 and 324.

**[0040]** While the exemplary embodiment of the invention will be described in relation to a transceiver having a number of transmitter portion latency paths and receiver portion latency paths, it should be appreciated that this invention can be applied to any transceiver having any number of latency paths. Moreover, it should be appreciated that the sharing of resources can be allocated such that one or more of the transmitter portion latency paths are sharing a shared resource, one or more of the receiver portion latency paths are sharing a shared resource, or a portion of the transmitter portion latency paths and a portion of the receiver portion latency paths are sharing shared resources. Moreover, any one or more of the latency paths, or portions thereof, could also be assigned to a fixed resource while, for example, another portion of the latency path(s) assigned to a shared resource. For example, in latency path 210, the interleaver 216 could be allocated a portion of the shared

memory 120, while the coder 214 could be allocated to a dedicated processing module, vice versa, or the like.

**[0041]** In accordance with the exemplary embodiment, a plurality of transmitter portion or receiver portion latency paths share an interleaver/deinterleaver memory, such as shared memory 120, and a coding module, such as shared processing module 110. For example, the interleaver/deinterleaver memory can be allocated to different interleavers and/or deinterleavers. This allocation can be based on parameters associated with the communication systems such as data rate, latency, BER, impulse noise protection, and the like, of the applications being transported. Similarly, a coding module, which can be a portion of the shared processing module 110, can be shared between any one or more of the latency paths. This sharing can be based on requirements such as data rate, latency, BER, impulse noise protection, and the like, of the applications being transported.

**[0042]** For example, an exemplary transceiver could comprise a shared interleaver/deinterleaver memory and could be designed to allocate a first portion of the shared memory 120 to an interleaver, such as interleaver 216 in the transmitter portion of the transceiver and allocate a second portion of the shared memory 120 to a deinterleaver, such as 316, in the receiver portion of the transceiver.

**[0043]** Alternatively, for example, an exemplary transceiver can comprise a shared interleaver/deinterleaver memory, such as shared memory 120, and be designed to allocate a first portion of shared memory 120 to a first interleaver, e.g.,

216, in the transmitter portion of the transceiver and allocate a second portion of the shared memory to a second interleaver, e.g., 226, in the transmitter portion of the transceiver.

**[0044]** Alternatively, for example, an exemplary transceiver can comprise a shared interleaver/deinterleaver memory and be designed to allocate a first portion of the shared memory 120 to a first deinterleaver, e.g., 316, in the receiver portion of the transceiver and allocate a second portion of the shared memory to a second deinterleaver, e.g., 326, in the receiver portion of the transceiver. Regardless of the configuration, in general any interleaver or deinterleaver, or grouping thereof, be it in a transmitter portion or receiver portion of the transceiver, can be associated with a portion of the shared memory 120.

**[0045]** Establishment, configuration and usage of shared resources is performed in the following exemplary manner. First, and in cooperation with the path module 140, the number of transmitter and receiver latency paths (N) is determined. The parameter determination module 130 then analyses one or more parameters such as data rate, transmitter data rate, receiver data rate, impulse noise protection, bit error rate, latency, or the like. Based on one or more of these parameters, the allocation module 150 allocates a portion of the shared memory 120 to one or more of the interleaver and/or deinterleavers, or groupings thereof. This process continues until the memory allocation has been determined and assigned to each of the N latency paths.

[0046] Having determined the memory allocation for each of the latency paths, and in conjunction with the shared resource management 160, the transceiver 100 transmits to a second transceiver one or more of the number of latency paths (N), the maximum interleaver memory for any one or more of the latency paths and/or the maximum total and/or shared memory for all of the latency paths.

[0047] Three examples of sharing interleaver/deinterleaver memory and coding processing in a transceiver are described below. The latency paths in these examples can be in the transmitter portion of the transceiver or the receiver portion of the transceiver.

[0048] Example #1

A first transmitter portion or receiver portion latency path may carry data from a video application, which needs a very low BER but can tolerate higher latency. In this case, the video will be transported using an latency path that has a large amount of interleaving/deinterleaving and coding (also known as Forward Error Correction (FEC) coding). For example, the latency path may be configured with Reed-Solomon coding using a codeword size of 255 bytes ( $N=255$ ) with 16 checkbytes ( $R=16$ ) and interleaving/deinterleaving using an interleaver depth of 64 ( $D=64$ ). This latency path will require  $N*D=16*255=16\text{Kbytes}$  of interleaver memory at the transmitter (or de-interleaver memory at the receiver). This latency path will be able to correct a burst of errors that is less than 512 bytes in duration.

[0049] A second transmitter portion or receiver portion latency path may carry an

internet access application that requires a medium BER and a medium amount of latency. In this case, the internet access application will be transported using a latency path that has a medium amount of interleaving and coding. For example, the latency path may be configured with Reed-Solomon coding using a codeword size of 128 bytes ( $N=128$ ) with 8 checkbytes ( $R=8$ ) and interleaving using an interleaver depth of 16 ( $D=32$ ). This latency path will require  $N \cdot D = 128 \cdot 32 = 4\text{Kbytes}$  of interleaver memory and the same amount of deinterleaver memory. This latency path will be able to correct a burst of errors that is less than 128 bytes in duration.

[0050] A third transmitter portion or receiver portion latency path may carry a voice telephony application, which needs a very low latency but can tolerate BER. In this case, the video will be transported using an latency path that has a large amount of interleaving and coding. For example, the third transmitter portion or receiver portion latency path may be configured with no interleaving or coding which will result in the lowest possible latency through the latency path but will provide no error correction capability.

[0051] According to the principles of this invention, a system carrying the three applications described above in Example #1, would have three latency paths that share one memory space containing at least  $(16+4)=20$  Kbytes. The three latency paths also share a common coding block that is able to simultaneously encode (in the transmitter portion) or decode (in a receiver portion) two codewords with  $N=255/R=16$  and  $N=128/R=8$ .

**[0052]** According to an exemplary embodiment of this invention, the latency paths can be reconfigured at initialization or during data transmission mode (also known as SHOWTIME in ADSL and VDSL transceivers). This would occur if, for example, the applications or application requirements were to change.

**[0053]** Example #2

If instead of 1 video application, 1 internet application and 1 voice application, there were 3 internet access applications then the transmitter portion and/or receiver portion latency paths would be reconfigured to utilize the shared memory and coding module in a different way. For example, the system could be reconfigured to have 3 transmitter portion or receiver portion latency paths, with each latency path being configured with Reed-Solomon coding using a codeword size of 128 bytes ( $N=128$ ) with 8 checkbytes ( $R=8$ ) and interleaving using an interleaver depth of 16 ( $D=32$ ). Each latency path will require  $N*D=128*32=4\text{Kbytes}$  of interleaver memory and each block will be able to correct a burst of errors that is less than 128 bytes in duration. Based on the example of carrying the three internet access applications described, the three latency path share one memory space containing at least  $3*4=12\text{ Kbytes}$ . Also the three latency paths share a common coding block that is able to simultaneously encode (on the transmitter side) or decode (on the receiver side) three codewords with  $N=128/R=16$ ,  $N=128/R=8$  and  $N=128/R=8$ .

**[0054]** Example #3

The system could be configured to carry yet another set of applications. For example, the latency paths could be configured to carry 2 video applications. In this case only



2 transmitter portion or receiver portion latency paths are needed, which means that the third latency path could be simply disabled. Also, assuming that the memory is constrained based on the first example above, then the maximum shared memory for these 2 latency paths is 20 kBytes. In this case, the system could be reconfigured to have 2 latency paths, with each block being configured with Reed-Solomon coding using a codeword size of 200 bytes ( $N=200$ ) with 10 checkbytes ( $R=10$ ) and interleaving/deinterleaving using an interleaver depth of 50 ( $D=50$ ). Each latency path will require  $N*D=200*50=10\text{Kbytes}$  of interleaver memory and each block will be able to correct a burst of errors that is less than 250 bytes in duration. This configuration results in 20K of shared memory for both latency paths, which is the same as in the first example. In order to stay within the memory constraints of the latency paths, the error correction capability for each latency path is decreased to 250 bytes from 512 bytes in Example #1.

**[0055]** Another aspect of this invention is the how FCI configuration information is transmitted between a first modem and a second modem. FCI configuration information will depend on the requirements of the applications being transported over the DSL connection. This information may need to be forwarded during initialization in order to initially configure the DSL connection. This information may also need to be forwarded during SHOWTIME in order to reconfigure the DSL connection based on a change in applications or the application requirements.

**[0056]** According to one embodiment, a first modem determines the specific FCI configuration parameters, e.g.,  $N$ ,  $D$ ,  $R$  as defined above, needed to meet specific

application requirements, such as latency, burst error correction capability, etc. In order to determine the FCI configuration parameters, the first modem must know what are the capabilities of a second modem. For example, the first modem must know how many latency paths (FCI blocks) the second modem can support. Also the first modem must know the maximum amount of interleaver memory for each transmitter latency path. In addition, since the transmitter latency paths may share a common memory space the first modem must know the total shared memory for all transmitter latency paths. This way the first modem will be able to choose a configuration that can meet application requirements and also meet the transmitter portion latency path capabilities of the second modem.

[0057] For example, using values from examples above, a first transceiver could send a message to a second transceiver during initialization or during SHOWTIME containing the following information:

- Number of supported transmitter and receiver latency paths = 3
- Max Interleaver Memory for latency path #1= 16 Kbytes
- Max Interleaver Memory for latency path #2= 16 Kbytes
- Max Interleaver Memory for latency path #3= 16 Kbytes
- Maximum total/shared memory for all latency paths = 20 kBytes

Based on this information, and the application requirements, the first transceiver would select latency path settings. For example, if the applications are 1 video, 1 internet access and 1 voice application, the first transceiver could configure 3 latency paths as follows:

latency path #1 – Video: N=255, R=16, D=64

latency path #2 – Video: N=128, R=8, D=32

latency path #3 – Video: N=0, R=0, D=1 (no coding or interleaving)

[0058] This would result in a total interleaver memory of 20 kbytes.

[0059] Alternatively, if for example, there are only 2 video applications, the first transceiver could configure 2 latency paths as follows:

latency path #1 – Video: N=200, R=10, D=50

latency path #2 – Video: N=200, R=10, D=50

latency path #3 – Video: N=0, R=0, D=1 (no coding or interleaving)

[0060] This would also result in a total interleaver memory of 20 kbytes.

[0061] Alternatively, the second transceiver can determine the specific FCI configuration parameters, e.g., N, D, R as defined above, needed to meet specific application requirements, such as latency, burst error correction capability, etc. As described above for the first transceiver, in order to determine the FCI configuration parameters, the second transceiver must first know what are the capabilities of the first transceiver. In this case, the first transceiver would send a message to the second transceiver containing the information described above and based on this information and the application requirements the second transceiver would select latency path settings.

[0062] Fig. 2 outlines an exemplary method of allocating shared memory in a transceiver. More specifically, control begins in step S200 and continues to step S210. In step S210, one or more of shared interleaver/deinterleaver memory and/or shared coder/decoder processing resources are allocated to one or more latency paths, in a transceiver. Control then continues to step S220 where the control sequence ends.

[0063] Fig. 3 outlines an exemplary method of exchanging shared resource allocations according to an exemplary embodiment of this invention. In particular, control begins in step S310. In step S310, a maximum amount of shared memory that can be allocated to a specific interleaver or deinterleaver of a plurality of interleavers or deinterleavers in a transceiver is determined. Next, in step S320, the determined maximum amount for one or more of the deinterleavers and/or interleavers is transmitted to another transceiver. Messages containing additional information can also be transmitted to the other transceiver and/or received from the other transceiver. Control then continues to step S330 where the control sequence ends.

[0064] Fig. 4 outlines an exemplary procedure for resource sharing according to an exemplary embodiment of this invention. In particular, control begins in step S400 and continues to step S410. In step S410, the number of latency paths are determined. Then, in step S420, the latency path information (FCI block information) is transmitted to another transceiver. Messages containing additional information can also be transmitted to the other transceiver and/or received from the other transceiver. This information can be used to, for example, assist with the determination of

memory allocation in the transceiver. Moreover, the messages received from the other transceiver could specify what the memory allocation is to be based on, for example, the number of latency paths, memory allocation in the remote transceiver and required applications. Control then continues to step S430.

[0065] In step S430, and for each latency path, the steps in step 440 are performed.

[0066] In step S440, and while monitoring of allocation of resources is being performed, steps 450 and 460 are performed. More specifically, in step S450, one or more parameters associated with the communication system are determined. Then, in step S460, shared resources are allocated based on one or more of the communication parameters. Control then continues to step S470.

[0067] In step S470, the allocation of shared resources is communicated to another transceiver. Next, in step S480, a determination is made as to whether there is a change in communications that would require the adjustment of the shared resource allocation. Examples of changes in communications conditions include a change in applications being transported over the system and/or changes in the channel condition, etc. If adjustments are required, control jumps back to step S410. Otherwise, control jumps to step S490 where the control sequence ends.

[0068] The above-described system can be implemented on wired and/or wireless telecommunications devices, such a modem, a multicarrier modem, a DSL modem, an

ADSL modem, an XDSL modem, a VDSL modem, a linecard, test equipment, a multicarrier transceiver, a wired and/or wireless wide/local area network system, a satellite communication system, a modem equipped with diagnostic capabilities, or the like, or on a separate programmed general purpose computer having a communications device or in conjunction with any of the following communications protocols: CDSL, ADSL2, ADSL2+, VDSL1, VDSL2, HDSL, DSL Lite, IDSL, RADSL, SDSL, UDSL or the like.

[0069] Additionally, the systems, methods and protocols of this invention can be implemented on a special purpose computer, a programmed microprocessor or microcontroller and peripheral integrated circuit element(s), an ASIC or other integrated circuit, a digital signal processor, a hard-wired electronic or logic circuit such as discrete element circuit, a programmable logic device such as PLD, PLA, FPGA, PAL, a modem, a transmitter/receiver, any comparable means, or the like. In general, any device capable of implementing a state machine that is in turn capable of implementing the methodology illustrated herein can be used to implement the various communication methods, protocols and techniques according to this invention.

[0070] Furthermore, the disclosed methods may be readily implemented in software using object or object-oriented software development environments that provide portable source code that can be used on a variety of computer or workstation platforms. Alternatively, the disclosed system may be implemented partially or fully in hardware using standard logic circuits or VLSI design. Whether software or

hardware is used to implement the systems in accordance with this invention is dependent on the speed and/or efficiency requirements of the system, the particular function, and the particular software or hardware systems or microprocessor or microcomputer systems being utilized. The communication systems, methods and protocols illustrated herein can be readily implemented in hardware and/or software using any known or later developed systems or structures, devices and/or software by those of ordinary skill in the applicable art from the functional description provided herein and with a general basic knowledge of the computer and telecommunications arts.

**[0071]** Moreover, the disclosed methods may be readily implemented in software that can be stored on a storage medium, executed on programmed general-purpose computer with the cooperation of a controller and memory, a special purpose computer, a microprocessor, or the like. In these instances, the systems and methods of this invention can be implemented as program embedded on personal computer such as an applet, JAVA® or CGI script, as a resource residing on a server or computer workstation, as a routine embedded in a dedicated communication system or system component, or the like. The system can also be implemented by physically incorporating the system and/or method into a software and/or hardware system, such as the hardware and software systems of a communications transceiver.

**[0072]** It is therefore apparent that there has been provided, in accordance with the present invention, systems and methods for sharing resources. While this invention has been described in conjunction with a number of embodiments, it is

evident that many alternatives, modifications and variations would be or are apparent to those of ordinary skill in the applicable arts. Accordingly, it is intended to embrace all such alternatives, modifications, equivalents and variations that are within the spirit and scope of this invention.



Claims:

1. A method for sharing resources in a transceiver comprising:  
allocating a first portion of shared memory to a first latency path and  
allocating a second portion of the shared memory to a second latency path.
2. The method of claim 1, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.
3. The method of claim 1, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.
4. The method of claim 1, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.
5. The method of claim 1, further comprising transmitting to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.
6. The method of claim 1, further comprising receiving from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.
7. The method of claim 1, further comprising allocating a shared processing module to a plurality of coding and/or decoding modules.
8. The method of claim 1, wherein the allocating of at least one portion of the shared memory is based on one or more communication parameters.
9. The method of claim 8, wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (BER).

10. A transceiver comprising:  
a first portion of shared memory that is allocated to a first latency path;  
and  
a second portion of the shared memory that is allocated to a second latency path.
11. The transceiver of claim 10, further comprising:  
an allocation module designed to allocate the shared memory based on one or more communication parameters.
12. The transceiver of claim 11, wherein at least one of the communication parameters is a data rate, a latency, an INP value or a Bit Error Rate (BER).
13. The transceiver of claim 10, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.
14. The transceiver of claim 10, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.
15. The transceiver of claim 10, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.
16. The transceiver of claim 10, further comprising a shared resource management module designed to determine information that is transmitted to another transceiver, wherein the information is used to determine a maximum amount of shared memory that can be allocated.
17. The transceiver of claim 10, further comprising a shared resource management module designed to utilize information that is received from another transceiver, wherein the information is used to determine a maximum amount of shared memory that can be allocated.

18. The transceiver of claim 10, further comprising a shared processing module designed to provide processing resources to a plurality of coding and/or decoding modules.

19. A system for sharing resources in a transceiver comprising:  
means for allocating a first portion of shared memory to a first latency path and means for allocating a second portion of the shared memory to a second latency path.

20. The system of claim 19, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.

21. The system of claim 19, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.

22. The system of claim 19, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.

23. The system of claim 19, further comprising means for transmitting to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

24. The system of claim 19, further comprising means for receiving from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

25. The system of claim 19, further comprising means for allocating a shared processing module to a plurality of coding and/or decoding modules.

26. The system of claim 19, wherein the allocating of at least one portion

of the shared memory is based on one or more communication parameters.

27. The system of claim 26, wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (BER).

28. A protocol for sharing resources in a transceiver comprising:  
allocating a first portion of shared memory to a first latency path and  
allocating a second portion of the shared memory to a second latency path.

29. The protocol of claim 28, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.

30. The protocol of claim 28, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.

31. The protocol of claim 28, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.

32. The protocol of claim 28, further comprising transmitting to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

33. The protocol of claim 28, further comprising receiving from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

34. The protocol of claim 28, further comprising allocating a shared processing module to a plurality of coding and/or decoding modules.

35. The protocol of claim 28, wherein the allocating of at least one portion of the shared memory is based on one or more communication parameters.

36. The protocol of claim 35, wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (BER).

37. An information storage media having stored thereon information that when executed allows sharing of resources in a transceiver comprising:  
information that allocates a first portion of shared memory to a first latency path and information that allocates a second portion of the shared memory to a second latency path.

38. The media of claim 37, wherein the first latency path includes an interleaver and the second latency path includes an interleaver.

39. The media of claim 37, wherein the first latency path includes an interleaver and the second latency path includes a deinterleaver.

40. The media of claim 37, wherein the first latency path includes a deinterleaver and the second latency path includes a deinterleaver.

41. The media of claim 37, further comprising information that transmits to another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

42. The media of claim 37, further comprising information that receives from another transceiver information that is used to determine a maximum amount of shared memory that can be allocated.

43. The media of claim 37, further comprising information that allocates a shared processing module to a plurality of coding and/or decoding modules.

44. The media of claim 37, wherein the allocating of at least one portion of

the shared memory is based on one or more communication parameters.

45. The media of claim 44, wherein at least one of the communication parameters is a data rate, a latency, an INP value or a bit error rate (BER).

ABSTRACT

A transceiver is designed to share memory and processing power amongst a plurality of transmitter and/or receiver latency paths, in a communications transceiver that carries or supports multiple applications. For example, the transmitter and/or receiver latency paths of the transceiver can share an interleaver/deinterleaver memory. This allocation can be done based on the data rate, latency, BER, impulse noise protection requirements of the application, data or information being transported over each latency path, or in general any parameter associated with the communications system.

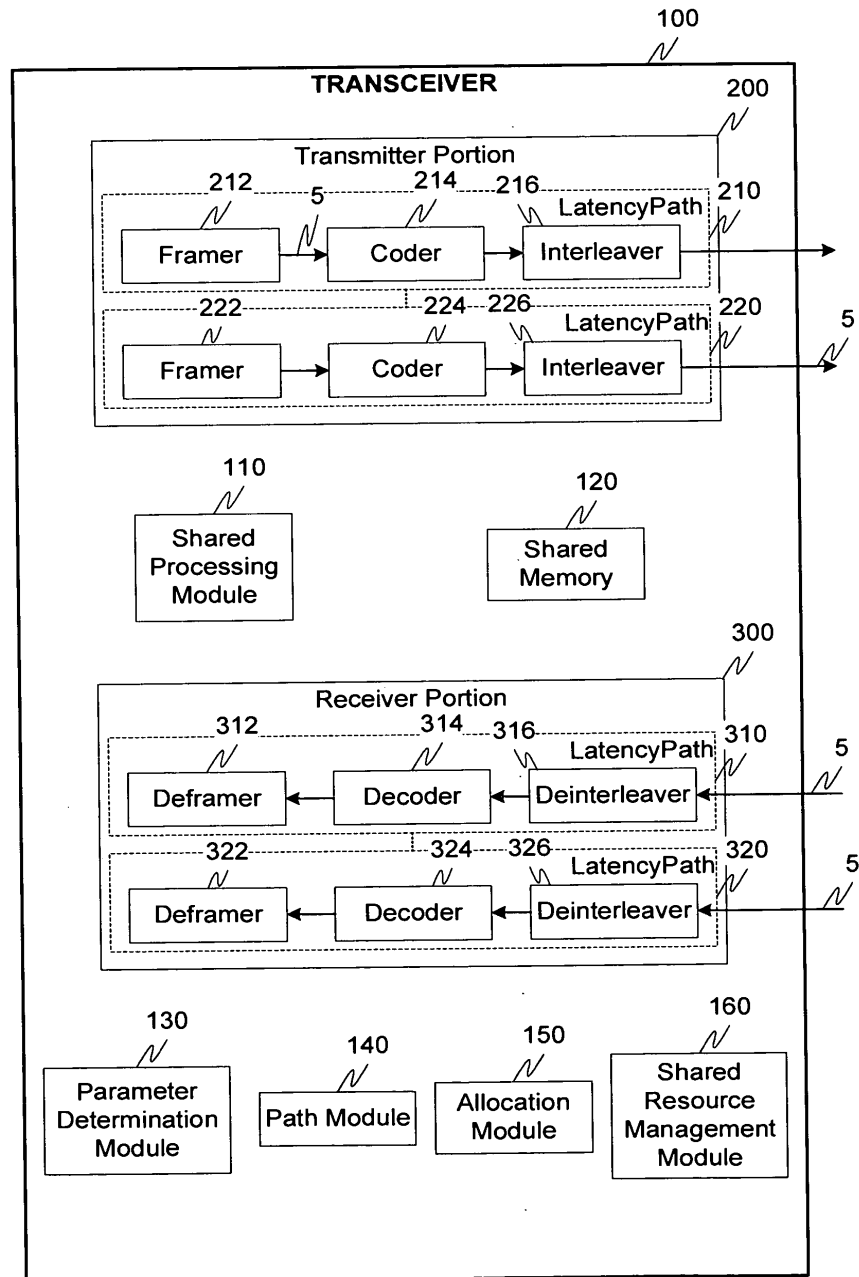


Fig. 1



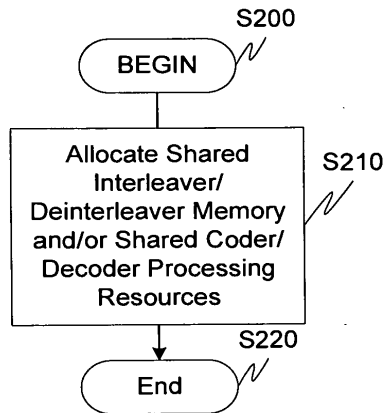


Fig. 2

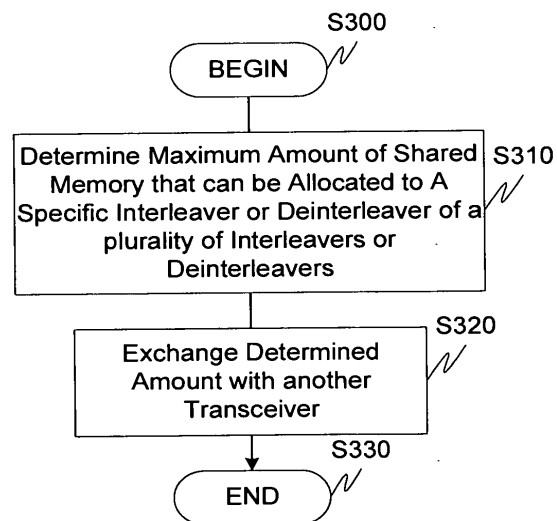


Fig. 3

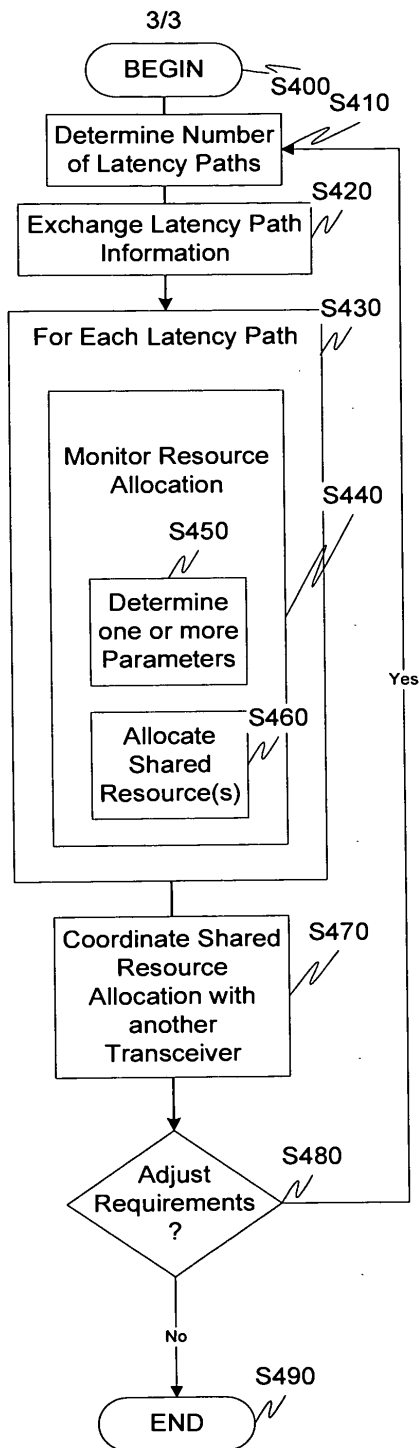


Fig. 4

PATENT APPLICATION SERIAL NO \_\_\_\_\_

U.S. DEPARTMENT OF COMMERCE  
PATENT AND TRADEMARK OFFICE  
FEE RECORD SHEET

10/13/2005 DTESSEM1 00000080 11246163

|            |            |
|------------|------------|
| 01 FC:1011 | 300.00 OP  |
| 02 FC:1111 | 500.00 OP  |
| 03 FC:1311 | 200.00 OP  |
| 04 FC:1202 | 1250.00 OP |
| 05 FC:1201 | 400.00 OP  |

PTO-1556  
(5/87)

U.S. Government Printing Office: 2002 — 498-247/69033

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

## PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875 Effective December 8, 2004

Application or Docket Number

11246163

APPLICATION AS FILED - PART I

(Column 1)

(Column 2)

### · SMALL ENTITY

OR

OTHER THAN  
SMALL ENTITY

| FOR                                              | NUMBER FILED                                                                                                                                                                                                                  | NUMBER EXTRA |
|--------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| BASIC FEE<br>(37 CFR 1.16(a), (b), or (c))       | N/A                                                                                                                                                                                                                           | N/A          |
| SEARCH FEE<br>(37 CFR 1.16(b), (d), or (m))      | N/A                                                                                                                                                                                                                           | N/A          |
| EXAMINATION FEE<br>(37 CFR 1.16(a), (b), or (d)) | N/A                                                                                                                                                                                                                           | N/A          |
| TOTAL CLAIMS<br>(37 CFR 1.16(n))                 | 45 minus 20 =                                                                                                                                                                                                                 | 25           |
| INDEPENDENT CLAIMS<br>(37 CFR 1.16(n))           | 5 minus 3 =                                                                                                                                                                                                                   | 2            |
| APPLICATION SIZE FEE<br>(37 CFR 1.16(d))         | If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s). |              |

MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))

\* If the difference in column 1 is less than zero, enter "0" in column 2.

| RATE (\$) | FEE (\$) |
|-----------|----------|
| N/A       | 150.00   |
| N/A       | \$250    |
| N/A       | \$100    |
| X\$ 25 -  |          |
| X100 -    |          |
|           |          |
| +180=     |          |
| TOTAL     |          |

| RATE (\$) | FEE (\$) |
|-----------|----------|
| N/A       | 300.00   |
| N/A       | \$500    |
| N/A       | \$200    |
| X\$50     | 1250     |
| X200      | 400      |
|           |          |
| +360=     |          |
| TOTAL     | 2650     |

APPLICATION AS AMENDED – PART II

(Column: 1)

(Column 2)

(Column 3)

SMALL ENTITY

OR

OTHER THAN  
SMALL ENTITY

| AMENDMENT A                                                     | CLAIMS<br>REMAINING<br>AFTER<br>AMENDMENT |       | HIGHEST<br>NUMBER<br>PREVIOUSLY<br>PAID FOR | PRESENT<br>EXTRA |
|-----------------------------------------------------------------|-------------------------------------------|-------|---------------------------------------------|------------------|
|                                                                 | Total<br>(37 CFR 1.16(d))                 | Minus | **                                          | =                |
|                                                                 | Independent<br>(37 CFR 1.16(n))           | Minus | ***                                         | =                |
| Application Size Fee (37 CFR 1.16(s))                           |                                           |       |                                             |                  |
| FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(o)) |                                           |       |                                             |                  |

| RATE (\$)        | ADDITIONAL FEE (\$) |
|------------------|---------------------|
| X\$ 25 =         |                     |
| X100 =           |                     |
|                  |                     |
| +180=            |                     |
| TOTAL ADD'L FEE. |                     |

| SMALL ENTITY |                 |                     |
|--------------|-----------------|---------------------|
|              | RATE (\$)       | ADDITIONAL FEE (\$) |
| OR           | X\$50           |                     |
| OR           | X200            |                     |
| OR           |                 |                     |
| OR           | +360=           |                     |
| OR           | TOTAL ADD'L FEE |                     |

| AMENDMENT #                                                     | (Column 1)                                | (Column 2)                                  | (Column 3)       |
|-----------------------------------------------------------------|-------------------------------------------|---------------------------------------------|------------------|
|                                                                 | CLAIMS<br>REMAINING<br>AFTER<br>AMENDMENT | HIGHEST<br>NUMBER<br>PREVIOUSLY<br>PAID FOR | PRESENT<br>EXTRA |
| Total<br>(37 CFR 1.16(d))                                       | *                                         | Minus **                                    | =                |
| Independent<br>(37 CFR 1.16(d))                                 | *                                         | Minus ***                                   | =                |
| Application Size Fee (37 CFR 1.16(s))                           |                                           |                                             |                  |
| FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(d)) |                                           |                                             |                  |

|                 |                      |
|-----------------|----------------------|
| RATE (\$):      | ADDITIONAL FEE (\$): |
| X\$ 25 =        |                      |
| X100 =          |                      |
|                 |                      |
| +180=           |                      |
| TOTAL ADD'L FEE |                      |

|    | RATE (\$) |   | ADDITIONAL FEE (\$) |
|----|-----------|---|---------------------|
| OR | X\$50     | = |                     |
| OR | X200      | = |                     |
|    |           |   |                     |
| OR | +360      | = |                     |
| OR | TOTAL     |   |                     |
|    | ADD'L FEE |   |                     |

- If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
- If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
- If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1460, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

## APPLICATION DATA SHEET

Electronic Version v14

Stylesheet Version v14.1

*Applicant Information:*Inventor 1:

|                                 |                |
|---------------------------------|----------------|
| Applicant Authority Type:       | Inventor       |
| Citizenship:                    | US             |
| Given Name:                     | Marcos         |
| Middle Name:                    | C.             |
| Family Name:                    | TZANNES        |
| City of Residence:              | Orinda         |
| State of Residence:             | CA             |
| Country of Residence:           | US             |
| Address-1 of Mailing Address:   | 121 La Espiral |
| Address-2 of Mailing Address:   |                |
| City of Mailing Address:        | Orinda         |
| State of Mailing Address:       | CA             |
| Postal Code of Mailing Address: | 94563          |
| Country of Mailing Address:     | US             |
| Phone:                          |                |
| Fax:                            |                |
| E-mail:                         |                |

Inventor 2:

|                               |                  |
|-------------------------------|------------------|
| Applicant Authority Type:     | Inventor         |
| Citizenship:                  | US               |
| Given Name:                   | Michael          |
| Family Name:                  | LUND             |
| City of Residence:            | West Newton      |
| State of Residence:           | MA               |
| Country of Residence:         | US               |
| Address-1 of Mailing Address: | 110 Prospect St. |
| Address-2 of Mailing Address: |                  |
| City of Mailing Address:      | West Newton      |

|                                 |       |
|---------------------------------|-------|
| State of Mailing Address:       | MA    |
| Postal Code of Mailing Address: | 02465 |
| Country of Mailing Address:     | US    |
| Phone:                          |       |
| Fax:                            |       |
| E-mail:                         |       |

|                                    |     |       |
|------------------------------------|-----|-------|
| <i>Correspondence Information:</i> |     |       |
| Customer Number:                   | 181 | *181* |

|                                    |                                                      |
|------------------------------------|------------------------------------------------------|
| <i>Application Information:</i>    |                                                      |
| Title of Invention:                | RESOURCE SHARING IN A TELECOMMUNICATIONS ENVIRONMENT |
| Application Type:                  | regular, utility                                     |
| Attorney Docket Number:            |                                                      |
| Botanic Information:               |                                                      |
| Publication Information:           |                                                      |
| Suggested Figure for Publication - |                                                      |
| Suggested Classification -         |                                                      |
| Suggested Technology Center -      |                                                      |
| Total Number of Drawing Sheets -   |                                                      |

|                                                                                                                                                                                  |       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| <i>Representative Information:</i>                                                                                                                                               |       |
| practitioner(s) at Customer Number:                                                                                                                                              |       |
| 181                                                                                                                                                                              | *181* |
| as our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith. |       |

|                                       |  |
|---------------------------------------|--|
| <i>Domestic Priority Information:</i> |  |
|---------------------------------------|--|

This is a Non-Provisional of US application number 60/618,269, filed 2004-10-12.

*Foreign Priority Information:*

*Assignee Information:*

Assignee 1:

Organization Name: Aware, Inc.  
Address-1 of Mailing Address: 40 Middlesex Turnpike  
Address-2 of Mailing Address:  
City of Mailing Address: Bedford  
State of Mailing Address: MA  
Postal Code of Mailing Address: 01730  
Country of Mailing Address: US  
Phone:  
Fax:  
E-mail: