



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.
11/199,586	08/08/2005	Xiaodong Li	68144/P014C1/10503148	1128
29053 7590 07/09/2007 FULBRIGHT & JAWORSKI L.L.P 2200 ROSS AVENUE SUITE 2800 DALLAS, TX 75201-2784			EXAMINER ZEWDU, MELESS NMN	
			ART UNIT 2617	PAPER NUMBER
			MAIL DATE 07/09/2007	DELIVERY MODE PAPER

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.

Office Action Summary

Application No.

11/199,586

Applicant(s)

LI ET AL.

Examiner

Meless N. Zewdu

Art Unit

2617

-- 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 23 April 2007.
- 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) 1-4,7,8,12-20,23,26,27,29-33,36,37,43-49,52,55,56 and 58-62 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- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.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) 1-4,7,8,12-20,23,26,27,29-33,36,37,43-49,52,55,56 and 58-62 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:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ 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)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____.
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- ☐ Notice of Informal Patent Application
- ☐ Other: _____.

DETAILED ACTION

1. This action is in response to the communication filed on 4/23/07.
2. In reviewing applicant's request for Pre-appeal review request, some discrepancies were discovered in the final rejection. One is the use Schneller with regard to ODP. The other was that finality was made on a De abstract. A consensus was reached to **re-open prosecution** and to modify the rejection based on the now translated De document.
3. Claims 5-6, 9-11, 21-22, 24-25, 28, 34-35, 38-42, 50-51, 53-54 and 57 have been canceled.
4. Claims 1-4, 7-8, 12-20, 23, 26-27, 29-33, 36-37, 43-49, 52, 55-56 and 58-62 are pending in this action.

Claim Objections

Claim 59 is objected to because of the following informalities: the claim has been made dependant on a canceled claim 57. For examination purpose, examiner considered claim 59 as depending on claim 58. Appropriate correction is required.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 1-4, 7-8, 12-15, 17-20, 22, 26-27, 29-33, 36-37, 43-49, 52, 55-56 and 58-62 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-23 of U.S. Patent No. 6,947,748 B2. Although the conflicting claims are not identical, they are not patentably distinct from each other because the difference between the claims in the instant application and claims in the patent is that the claims in the instant application are broader than the claims in the patent. For example, consider the independent claims in the patent; each of these claims includes all or part of the features of independent claims in the instant application. But, considering the claims in the patent in general, one can find all the features claimed in the instant application present therein.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 12, 14, 17-18, 30, 43 and 46-47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ritter (DE 19800953 C1) (translated version) in view of Larsson et al. (Larsson) (US 5,956,642).

As per claim 1: Ritter discloses a method for sub-carrier selection for a system employing orthogonal frequency division multiple access (OPDMA) (see abstract), comprising:

a subscriber unit measuring channel for a plurality of sub-carriers (page 5, lines 16-19) based on pilot symbols received from a base station (see page 7, lines 1-9; page 12, lines 12-17);

the subscriber unit selecting a set of candidate sub-carriers (see page 5, line 11- page 6, line 6);

the subscriber unit providing feedback information on the set of candidate sub-carriers to the base station (see page 5, lines 16-21);

the subscriber unit receiving an indication of sub-carriers of the set of sub-carriers selected by the base station for use by the subscriber (see page 5, line 22-page 6, line 6). Examiner considers the claimed plurality of measured sub-carriers as

Art Unit: 2617

subsets of the prior art's "various segments." Ritter also discloses that inter-cell and inter-symbol interferences are considered and compensated (see page 6, lines 19-23). But, Ritter does not explicitly teach about a subscriber unit measuring interference information, as claimed by applicant. However, in the same field of endeavor, Larsson teaches about an adaptive channel allocation wherein a mobile unit measures the interference level (I) of all N available channels (see col. 5, lines 6-21). Therefore, it would have been obvious for one of ordinary skill in the art at the time the invention was made to modify the teaching of Ritter with that of Larsson for the advantage of enabling Ritter's communication system to allocate resources adaptively with less dropped calls and better quality communication for each link (see col. 18, lines 20-39, particularly lines 28-29). 16-19).

As per claim 2: Ritter teaches a method further comprising the subscriber unit sending the indication to the base station (see page 5, lines 16-21).

As per claim 12: Ritter teaches a method wherein the pilot symbols occupy an entire OFDM frequency bandwidth (see page 3, lines 9-19).

As per claim 13: Ritter teaches a method wherein at least one other pilot symbol from a different cell transmitted at the same time as the pilot symbols received from the base station collide each other (see page 6, lines 19-23). Collision is a function of inter-cell interference.

As per claim 14: Ritter teaches a method further comprising the base station selecting the subcarriers from a set of candidate subcarriers based on additional information available to the base station (see (see page 5, line 11-page 6, line 6; page 6, lines 19-

Art Unit: 2617

23). For example, the inter-cell interference could be considered as additional information. Furthermore, examiner considers the claimed sub-carriers as being the subset of the prior art segment frequency spectrum.

As per claim 17: Ritter teaches a method wherein the indication of sub-carriers is received via a downlink control channel (see page 5, line 5-page 6, line 6; page 23, lines 8-19).

As per claim 18: Ritter teaches a method wherein the plurality of sub-carriers comprises all sub-carriers allocable by a base station (see page 5, line 11-page 6, line 6).

As per claim 30: the features of claim 30 are similar to the features of claim 1, except claim 30 is directed to an apparatus intended to perform the steps of method claim 1. Hence, since the method steps of claim 1 are taught and the apparatus of claim 30 is required to perform the steps of claim 1, claim 30 has been rejected on the same ground and motivation as claim 1.

As per claim 43: the feature of claim 43 is similar to the feature of claim 14. Hence, claim 43 is rejected on the same ground and motivation as claim 14.

As per claim 46: Ritter teaches an apparatus wherein the indication of sub-carriers is received via a downlink control channel between the base station and the at least one subscriber (see page 27, line 23-page 28, line 6). It is known to transmit/receive control information via a control channel and it is also known that a transmission from the base to the mobile unit is via a down link channel..

Art Unit: 2617

As per claim 47: Ritter teaches an apparatus wherein the plurality of sub-carriers comprises all sub-carriers allocable by a base station (see page 5, line 22-page 6, line 6; page 6, lines 7-18).

Claims 3-4, 19, 20, 23, 48, 49, 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over the references applied to claim 1 above, and further in view Yan et al. (Yan) (US 6,553,011 B1).

As per claim 3: the references applied to claim 1 above do not explicitly teach about sending an indication of the group of clusters selected by the base station for use by the subscriber unit, as claimed by applicant. However, in the same field of endeavor, Yan teaches about a cellular multicarrier wireless communication system wherein mobile station is configured to receive signaling information on a common group of sub-carriers within a cluster of two or more cells, in which the base stations transmitting on the common channel are each identified from a multiple access preamble transmitted in each frame to identify the base station (see col. 2, lines 44-54; claim 6). Therefore, it would have been obvious for one of ordinary person skilled in the art at the time the invention was made to further modify the above references with the teaching of Yan for the advantage of identifying a base station from which a group of sub-carrier signals is transmitted (see col. 1, lines 48-55).

As per claim 4: Ritter teaches a method further comprising the base station selecting sub-carriers for the subscriber based on inter-cell interference avoidance (see page 6, lines 19-23).

Art Unit: 2617

As per claim 19: Ritter teaches a method wherein providing feedback information comprises arbitrary ordering the set of candidate of subcarrier (see page 19, lines 11-16; claim 4), wherein the cluster of base stations are as provided in Yan's reference, as discussed the rejection of claim 3 above. Motivation is same as provide therein (in the rejection of claim 3).

As per claim 20: the feature of claim 20 is same as that of claim 19, except listing most desirable candidate clusters first, which is taught by Ritter (see page 19, lines 4-10; claim 4).

As per claim 23: the feature of claim 23 is similar to the feature of claim 20, wherein the sequential order recited in claim 23 reads on the priority order provided in Ritter's reference, as recited and discussed in the rejection of claim 19 above. Hence, claim 23 is rejected on the same ground and motivation as claim 19.

As per claim 48: the feature of claim 48 is similar to the feature of claim 19. Hence, claim 48 is rejected on the same ground and motivation as claim 19.

As per claim 49: the feature of claim 49 is similar to the feature of claim 20. Hence, claim 49 is rejected on the same ground and motivation as claim 20.

As per claim 52: the feature of claim 52 is similar to the feature of claim 19, wherein the sequential order recited in claim 23 reads on the priority order provided in Ritter's reference, as recited in the rejection of claim 19. Hence, claim 52 is rejected on the same ground and motivation as claim 19.

Art Unit: 2617

Claims 15, 16, 44 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over the references applied to the claims above, and further in view of Westroos et al. (Westroos) (US 6,327,472).

As per claim 15: but, the above mentioned references do not explicitly teach about a base station having additional information that comprises traffic load information on each cluster of sub-carriers, as claimed by applicant. However, in the same field of endeavor, Westroos teaches about the use of a load monitoring device that collects and holds traffic information on neighboring cells (see col. 2, line 44-col. 3, line 10; col.5, lines 19-65). Therefore, it would have been obvious for one of ordinary skill in the art at the time the invention was made to further modify the above references with the teaching of Westroos for the advantage of making load dependent channel allocation.

Note: although Westroos' traffic load information collector/holder is residing in the MSC, it is by choice of design. It could have been placed in, for example, the BSC or BS, as well.

As per claim 16: Westroos teaches a method wherein the traffic load information is provided by a data buffer in the base station (see col. 5, lines 45-65). Also, see the explanation above.

As per claim 44: but, the above mentioned references do not explicitly teach about a base station having additional information that comprises traffic load information on each cluster of sub-carriers, as claimed by applicant. However, in a related field of endeavor, Westroos teaches about the use of load monitoring device that collects and

Art Unit: 2617

holds traffic information on neighboring cells (see col. 2, line 44-col. 3, line 10; col. 5, lines 19-65). Motivation is same as provided in the rejection of claim 15 above.

As per claim 45: Westroos teaches an apparatus wherein the traffic load information is provided by a data buffer in the base station (see col. 5, lines 45-65). Also, see the explanation above.

Claims 29 and 62 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ritter. In view of Yan et al. and further in view of Feuerstein et al. (Feuerstein) (US 6,141,565).

As per claim 29: Ritter discloses an apparatus (see fig. 1; abstract), comprising:

a plurality of subscribers in a first cell (a cell) (see fig. 1) to generate feedback information indicating group of sub-carriers desired for use by the plurality of subscribers (see page 4, line 17-page 6, line 6). The mobile station of the prior art is in a cell.

a first base station (see fig. 1, element BS) in a first cell, the first base station performing subcarrier allocation for OFDMA to allocate OFDMA subcarriers to the plurality of subscriber units (see page 4, line 17-page 5, line 10) based on inter-cell interference avoidance in response to the feedback information (see page 6, line 19-page 7, line 9). Since there is no a second cell and a second base station mentioned, the prior art cell can be considered as a first cell and a first base station. But, Ritter does not explicitly teach about the use of a cluster of sub-carriers. However, in the same field of endeavor, Yan teaches about a cellular multi-carrier wireless communication system wherein mobile station is configured to receive signaling information on a common

Art Unit: 2617

group of sub-carriers within a cluster of two or more cells, in which the base stations transmitting on the common channel are each identified from a multiple access preamble transmitted in each frame to identify the base station (see col. 2, lines 44-54; claim 6). When the above references are modified as discussed hereinabove, the mobile feedback to the base station will include quality indication on the cluster of subcarriers. Therefore, it would have been obvious for one of ordinary person skilled in the art at the time the invention was made to further modify the above references with the teaching of Yan for the advantage of identifying a base station from which a group of sub-carrier signals is transmitted (see col. 1, lines 48-55).

But Ritter in view of Yan et al. does not explicitly teach about intra-cell traffic load balancing, as claimed by applicant. However, in a related field of endeavor, Feuerstein teaches about network optimization based on measured local interference and/or local traffic load conditions (see col. 2, lines 27-37). Therefore, it would have been obvious for one of ordinary skill in the art at the time the invention was made to modify Ritter in view of Yan with the teaching of Feuerstein's for the advantage of optimizing network parameters based on dynamic communication and network conditions such as traffic load and balancing conditions and/or changing interference conditions (see col. 1, lines 20-26).

As per claim 62: the features of claim 62 are similar to the features of claim 29. Hence, claim 62 is rejected on the same ground and motivation as claim 29.

Art Unit: 2617

Claims 58, 60 and 61 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ritter in view of Frodigh et al. (Frodigh) (US 5,726,978). For examination purpose, claim 58 is considered first.

As per claim 58: Ritter discloses a method comprising:

the base station allocating sub-carriers to establish a data link between the base station and the subscriber reads on '953 (see abstract). But, Ritter does not explicitly teach about a base station allocating a first portion of the sub-carriers and allocating a second portion of the sub-carriers to the subscriber to increase communication bandwidth, as claimed by applicant. However, in the same field of endeavor, Frodigh advantageously teaches about a method of adaptively allocating selected sub-carriers to subscribers (see col. 4, lines 32-67, particularly lines 65-67). Therefore, it would have been obvious for one of ordinary skill in the art at the time the invention was made to modify Ritter's reference with the teaching of Frodigh for the advantage of lessening co-channel interference between cells of the system (see col. 4, lines 25-31). Note: adaptive allocation of sub-carriers can increase or decrease a communication bandwidth.

As per claim 59: Frodigh teaches an method wherein the base station allocates the second portion after allocating each subscriber in the cell sub-carriers to establish a data link between the base station and said each subscriber (see col. 4, lines 32-49). Adaptive allocation can allow the base station to perform this feature priority.

As per claim 60: Ritter discloses a base station (see abstract), comprising:

Art Unit: 2617

means for allocating sub-carriers to establish a data link between the base station and the subscriber (see abstract). But, Ritter does not explicitly teach about a means for allocating a first portion and a second portion of the sub-carriers to a subscriber to increase communication bandwidth, as claimed by applicant. However, in a related field of endeavor, Frodigh teaches that in an OFDMA system subcarriers can be selected and adaptively allocated based on set allocation criteria (see col. 4, lines 32-49). Therefore, it would have been obvious for one of ordinary skill in the art at the time the invention was made to modify the teaching of Ritter with that of Frodigh for the advantage of lessening co-channel interference between cells of the system (see col. 4, lines 25-31). Note: adaptive allocation of sub-carriers can increase or decrease a communication bandwidth.

As per claim 61: Frodigh teaches an apparatus defined in Claim 60 wherein the base station allocates the second portion after allocating each subscriber in the cell sub-carriers to establish a data link between the base station and said each subscriber (see col. 4, lines 32-49). When the references are combined as shown above, bandwidth will be allocated adaptively.

Response to Arguments

Applicant's arguments with respect to claims 1-4, 7-8, 12-15, 17-20, 22, 26-27, 29-33, 36-37, 43-49, 52, 55-56 have been considered but are moot in view of the new ground(s) of rejection.

Applicant's argument with respect to claims 58 and 60, have been fully considered; but they are not persuasive. Arguments and responses are provided in the following paragraphs.

Argument: with regard to claims 58 and 60, applicant argues by saying Frodigh is silent as to how merely selecting a portion of available subcarriers will be used to affect the communication between a base station and a subscriber unit; and as such, Frodigh falls short of disclosing allocating a second portion of subcarriers to increase communication bandwidth.

Response: examiner respectfully disagrees with the argument. In that Frodigh, in addition to selecting subcarriers, as an initial allocation, teaches about increasing communication bandwidth by reconfiguring the subset of M subcarriers (previously allocated, which can be considered as a first portion) to include unused subcarriers (second portion) (see col. 4, lines 65-67). Hence, the argument is not persuasive and the rejection is, thus, upheld.

Remark: all pending claims are rejected on the ground of nonstatutory obviousness-type double patenting but not under 35 U.S.C. 103(a). Those claims that are omitted in the later rejection are thought to have allowable subject matter in view of the prior art

Art Unit: 2617

applied therein. Such indication does not include, for example claims 32 and 33 which depend on claim 31, as having allowable subject matter.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Meless N. Zewdu whose telephone number is (571) 272-7873. The examiner can normally be reached on 8:30 am to 5:00 pm..

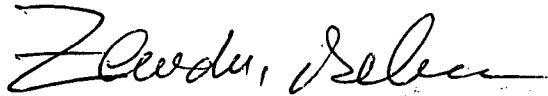
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Appiah Charles can be reached on (571) 272-7904. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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.

Art Unit: 2617

Any inquiry of a general nature relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (571) 272-2600.

Meless zewdu



Primary examiner

26 June 2007.

Notice of References Cited	Application/Control No. 11/199,586	Applicant(s)/Patent Under Reexamination LI ET AL.	
	Examiner Meless N. Zewdu	Art Unit 2617	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,553,011 B1	04-2003	Yan et al.	370/328
	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 Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N	19800953	07-1999	DE	Ritter	H04B 7/7005
	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.

PTO 07-4791

CC=DE
DATE=19990729
KIND=AN
PN=19800953

See pages 8-9 marked

Procedure and Radio Communication System to Allocate the
Radio Resources of a Radio Interface

Gerhard Ritter

UNITED STATES PATENT AND TRADEMARK OFFICE

WASHINGTON, DC

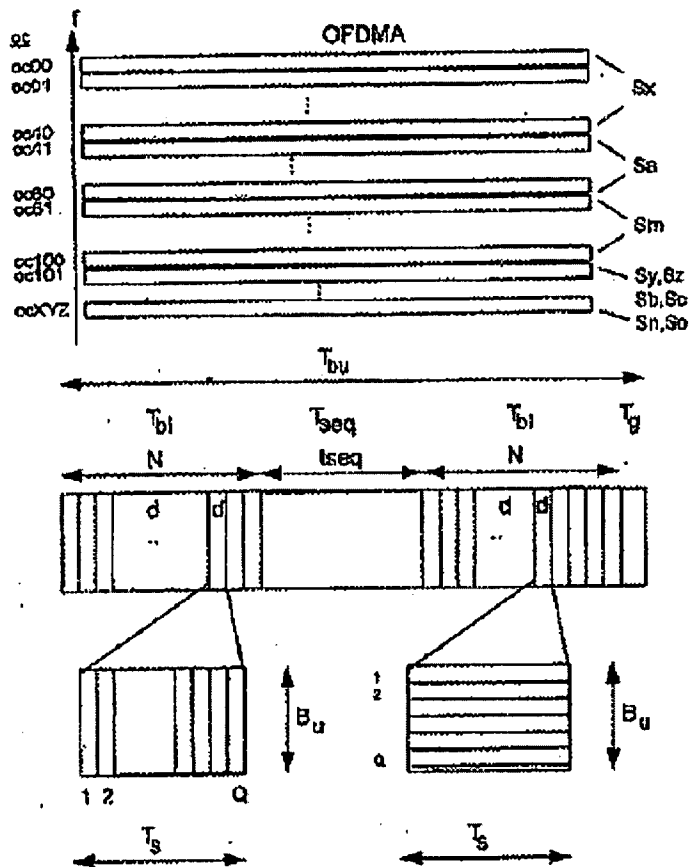
June 2007

Translated by: "SCHREIBER TRANSLATIONS INC."

PUBLICATION COUNTRY	(10): DE
DOCUMENT NUMBER	(11): 19800953
DOCUMENT KIND	(12): PS
PUBLICATION DATE	(43): 19990729
APPLICATION NUMBER	(21): 19800953.4-35
APPLICATION DATE	(22): 19980113
INTERNATIONAL CLASSIFICATION	(51): H04B 7/005, H04B 7/204, H04B 7/26, H04J 13/02, H04Q 7/38, H04L 27/00
PRIORITY COUNTRY	(33):
PRIORITY NUMBER	(31):
PRIORITY DATE	(32):
INVENTOR(S)	(72): Gerhard Ritter
PATENT HOLDER	(73): Siemens Inc.
DESIGNATED CONTRACTING STATES	(81):
TITLE	(54): Procedure and Radio Communication System to Allocate the Radio Resources of a Radio Interface
FOREIGN TITLE	[54a]: Verfahren und Funk- Kommunikationssystem zur Zuteilung von Funkressourcen einer Funkschnittstelle

Description

The invention involves a procedure to allocate the radio resources of a radio interface of a radio communications system as well as a corresponding radio communication system.



As is known radio communication systems manifest a radio interface across which data symbols can be transmitted between a fixed base station and usually several mobile station in a radio coverage area - e.g. a radio cell. In the process multiplex access procedures are

used, in order to be able to effectively use the radio resources of the radio interface. A classic multiple access procedure is the time multiplex (TDMA, Time Division Multiple Access) in which the data symbols are contained in bursts in a time slot. Another multiplex access procedure is the code multiplex (CDMA, Code Division Multiple Access) in which each data symbol is splayed with several code symbols on a certain bandwidth.

In addition, there is the OFDMA multi-carrier procedure (Orthogonal Frequency Division Multiple Access) which uses the OFDM principle to transmit the data symbols according to Chapter 15.3.2 of "Information Transmission", K. D. Kammeyer, Teubner Publishers, Stuttgart, 2nd Edition, 1996. Almost rectangular-shaped, transmission and reception filter impulse, responses enable a FFT (Fast Fourier Transformation) or an IFFT (Inverse Fast Fourier Transformation) based signal processing in the transmitter and receiver which allows for high data rates with relatively low complexity. It is also advantageous, that narrow band sub-carriers (OFDMA carriers) which, for example, can only be separated from each other by a few kilohertz enable a fine granularity of the data rates depending on the actual application. Thus a number of sub-carriers and also a segment of a frequency spectrum can be

allocated for the communication link between the base station and the mobile station.

From German Patent DE 4441323A1 a procedure is known to transmit OFDM signals in a mobile communication system in which for high transmission rates dynamically reduced OFDM signals can be amplified by a transmission amplifier within a basically linear amplification range.

The invention has the goal of providing an improved procedure and radio communication system for allocating radio resources, when using a OFDMA multi-carrier procedure.

This goal is achieved in the invention by the procedure with the characteristics of Patent Claim 1 and by a radio communication system with the characteristics of Patent Claim 12. Further variations of the inventions can be taken from the sub-claims.

17 The procedure of the invention begins with the OFDMA multi-carrier procedure and the use of a number of sub-carriers which are assigned for the communication link between the base station and the mobile stations and includes the following steps:

- Measure the quality of various segments of the frequency spectrum through each mobile station,

- Determine at least one suitable segment preferred for its own communication link through each mobile station and the transmission of appropriate information to the base station,
- 5 - Evaluate the information received from the mobile stations through the base station and allocate a/2 segment for the respective communication link to each mobile station depending on the evaluation,
- Transmit information across the allocated segment to each mobile station through the base station.

11 The radio communication system of the invention also begins with the OFDMA multi-carrier procedure and the use of a number of sub-carriers which are allocated for the communication link between the base station and the mobile station and includes the following means:

16 - Control means in each mobile station to measure the quality of various segments of the frequency spectrum and to determine at least a suitable segment preferred for its own communication link,

21 - Control means in each mobile station to transmit appropriate information to the base station,

- Control means in each base station to evaluate the information received from the mobile stations and to

allocate a segment for the respective communication link to each mobile station depending on the evaluation, as well as

- Transmission means in each base station to transmit information across the assigned segment to each mobile station.

By means of the allocation system described the advantages of the OFDMA multi-carrier procedure can be used and possibly optimal frequency resources can be provided for all communication links operated by a base station with the help of a flexible allocation of several sub-carriers and a thereby defined segment of a frequency spectrum. In the process, the quality of the actual communication link plays a decisive role with respect to the frequency situation which according to the procedure of the invention can be individually changed after the determination of the best suitable segments in each mobile station overseen by a base station and can thereby be improved.

allocati

19 Another important advantage consists of the fact, that by means of the invention the interferences, especially the critical inter-cell interference in the radio communication systems and the inter-symbol interferences, are considered and compensated for.

Inter-cell Interference

By means of the procedure of the invention and the radio communication system a cost effective and more effective - primarily for higher frequencies in the MHz range - allocation of frequency resources is obtained using the OFDMA multi-carrier procedure, as compared to a wideband communication. The improved OFDMA multi-carrier procedure can be combined with other multiplex access procedures which transmit data symbols of a finite duration in time slot into a more effective radio system. Thus the improved OFDMA multi-carrier procedure according to an especially preferred variant can be integrated into a TDMS/CDMA radio system which for applications with less power requirements - e.g., micro-cell systems - or for TDD applications (Time Division Duplex) or for applications with higher data rates - e.g., for indoor systems, wireless systems or for applications with low movement speeds acts in an especially advantageous manner.

The flexibility of the procedure of the invention can be especially used in an advantageous manner, if segments of the frequency spectrum are allocated to the mobile /3 stations by the base station whose bandwidths vary or a /2 different number of time slots for the transmission of data symbols are assigned to the allocated segments. Thus the best suited segments for communication can be determined at

any time for individual communications links which differ from each other and they can be changed as needed.

Mont
According to another version of the invention a priority list is sent from the mobile station to the base station which contains information about the segment best suited for its communication link as well as other suitable segments preferred for its own communication link. As a result, the base station receives knowledge from the incoming lists of the desires of the mobile station with respect to the best suited segment for it and can make appropriate new assignments of the segments of the frequency spectrum for all mobile stations which are better adapted to their transmitted needs.

It has proven useful, that the number of assigned sub-carriers in a time slot be set variably by the base station for each mobile station, in order to not only change the segments when needed but to also be able to change their bandwidth.

Another advantageous model of the invention to measure the quality of segments of the frequency spectrum envisions, that the mobile station receives all sub-carriers in the time slot allocated to it, checks for each sub-carrier, whether an amplitude modulation of the data symbols transmitted in the time slot is present, and forms

an average value from the results of the test for all sub-carriers belonging to the respective segment. The advantage lies in the two-step procedure in which initially the quality is determined for the individual sub-carriers and then the quality of the sub-carriers can be ascertained to determine the quality of the segment that was examined in particular.

An especially simple method to measure quality consists of so determining the relative deviations of the amplitudes of the data symbols, that the absolute amplitude difference from data symbol to data symbol is added up and the addition result is normalized with the average amplitude of all data symbols transmitted on a given sub-carrier.

According to another variant of the invention the radio communication system manifests a mobile station with a control means to measure the quality of various segments of the frequency spectrum and to determine at least one suitable segment preferred for its communication link, as well as a transmission means to transmit suitable appropriate information to the base station.

In another variation of the invention the radio communication device manifests a device which in alternative configurations is characterized as a part of

the base station or the base station control with a control means to evaluate the information received by the mobile stations and to allocate to each mobile station a segment for the communication link depending on the evaluation, as well as a transmission means to transmit information across the allocated segment to each mobile station.

In the following section the device of the invention will be described using execution models and references to the drawings.

Shown thereby

Figure 1 is a block diagram of a mobile radio system with several mobile stations overseen by a base station, /4

Figure 2 is a schematic depiction of a structure of a radio block with data symbols in a time slot as well as the OFDMA sub-carrier to form the segments of a frequency spectrum,

Figure 3 is an information flow to allocate frequency resources to the mobile stations,

Figure 4 is a schematic depiction of the amplitude modulation of the transmitted data symbols on a OFDMA sub-carrier to measure the quality of the segments,

Figure 5 is a block diagram of a mobile station, and

Figure 6 is a block diagram of a base station / base station control.

The radio communication system shown in Figure 1 corresponds in its structure to a known mobile radio system; the network devices of a mobile radio net, like e.g., the mobile relay positions, MSC, which are networked to each other provide the access to a fixed network, PSTN, and manifest base stations, BS, connected to a base station control, BSC, and the base station controls, BSC, connected with the mobile relay positions, MSC. Such a base station, BS, is a fixed radio station which establishes and maintains communication links to the mobile stations, MS, via a radio interface. Shown in Figure 1, for example, are three radio connections between the mobile stations, MS, and a base station, BS. An Operation and Maintenance Center, OMC, performs control and maintenance functions for the mobile radio system or for parts of it. The Operation and Maintenance Center, OMC, and the base station control, BSC, usually perform the functions of regulating and adapting the allocation of radio resources within the radio cells of the base station, BS. The functionality of the radio communication system can also be conveyed to another radio communication system, if necessary, even with a fixed

mobile station, MS. The procedure of the invention can even be used in such a radio communication system.

The communication links between the base station, BS, and the mobile stations, MS, are subject to a multiple path expansion which can also be caused by reflections, for example, off buildings or vegetation, in addition to a direct expansion path. If one assumes a movement of the mobile stations, MS, then the multiple path expansion together with other interference results in the signal components of the various expansion paths of a participant's signal being overlaid in time at the

12 receiving base station, BS. It will also be assumed, that a OFDMA multi-carrier procedure is used to transmit data symbols in time slots which assigns the mobile stations a number of sub-carriers and thus a segment of a frequency spectrum for the communication link between the base station, BS, and a mobile station, MS.

17 According to the device of the invention every mobile station, MS, measures the quality of various segments of the frequency spectrum, whereby it receives all sub-carriers in the time slot assigned to it, checks the quality of each individual sub-carrier and then determines the quality of the sub-carriers. Then each mobile station determines at least a suitable segment preferred for its

own communication link and transmits appropriate information to the base station, BS. In this example the first mobile station determines a segment, Sx, with sub-carriers oc00 ... 0c40 as the best suitable segment for it. In addition, it determines the segments, Sy, Sz as additional suitable segments preferred for its own communication link. Information about segments Sx, Sy, Sz

/5

is entered on a priority list, PL1, numbered according /3 to their suitability for the communication link and sent to the base station, BS.

In a similar manner, the second mobile station determines a segment, Sa, with sub-carriers oc41 ... oc60 as the suitable segment best for it. In addition, it determines segments, Sb, Sc, as additional suitable segments preferred for its own communication link. Information about segments Sa, Sb, Sc is entered on a priority list, PL2, numbered according to their suitability for the communication link and likewise is sent to the base station, BS.

Also the third mobile station, MS, overseen by the base station, BS, determines a segment, Sm, with sub-carriers, cc61 ... cc100 and the best suitable segment for its communication link. In addition, it provides in a

priority list, PL3, segments, Sn, So, as additional suitable segments preferred for its own communications link. The information about these three segments, Sm, Sn, So, which are numbered in the priority list, PL3, according to their suitability for the communication link, are also then sent to the base station, BS. It can be seen from the examples, that the number of sub-carriers co ... and thus the bandwidth of segments S ... can be variably selected.

The base station, BS, evaluates all information received from the mobile stations, MS, and assigns each mobile station a segment for the respective communication link depending on the evaluation. The base station sends the mobile station information about the assigned segment. It is assumed in this example, that each mobile station, MS, can be assigned the best suitable segment desired by it. That also depends on the transmission conditions and/or the capacity utilization of the radio cell overseen by the base station, BS, according to presets of the Operation and Maintenance Center, OMC, or the base station control, BSC, for radio resource management. Thus the first mobile station, MS, receives segment Sx, the second mobile station, MS, the segment Sa, and the third mobile station, MS, the segment Sm, accordingly with the appropriate OFDMA sub-carriers, co ..., assigned by the base station, BS. A

different number of time slots to transmit data symbols in the allocated segments can also be assigned to the individual mobile stations, MS.

The flexibility of the procedure of the invention is used in an especially advantageous manner, when segments of the frequency spectrum are allocated to the mobile stations, MS, by the base station, BS, whose bandwidths are different or there are different numbers of time slots for the transmission of data symbols in the assigned segments. Thus the best suited segments for communications are determined at any time for individual communications links which differ from each other and can be changed, if needed.

Shown schematically in Figure 2 is the structure of a radio block with data symbols in a time slot, as well as the OFDMA sub-carriers to form the segments according to the examples in Figure 1. There are thus available, for example, several hundred sub-carriers, oc , - with a separation of several kilohertz between two adjacent carriers - in the radio cell of Figure 1 with three mobile stations, MS, linked to the base station, BS. Sub-carriers $oc00 \dots oc40$ define segment S_x , sub-carriers $oc41 \dots oc60$ define segment S_a , and sub-carriers $oc61 \dots oc100$ define segment S_m , appropriately distributed by the base station to the mobile stations. Other sub-carriers $oc101 \dots ocXYZ/6$

are available in the entire frequency band usable for the net operator which also contains the segments S_y , S_z and S_b , S_c , and S_n , S_o with a number of sub-carriers also categorized as suitable by the mobile stations. According to Figure 2 an identical bandwidth is assumed for segments S_x , S_m . That, however, is no prerequisite for a radio communication system in the sense of the invention.

The radio block shown as an example in Figure 2 is transmitted in a time slot of a TDMA frame structure. Provided in each frame is at least one time slot for one or more participant signals. A preset number of sub-carriers is used by the base station in each time slot on which a preset number of data symbols is transmitted. In addition, for each mobile station the number of assigned sub-carriers in a time slot can be variably adjusted by the base station.

The duration of the radio block is designated with T_{bu} . The radio block includes two blocks each with N data symbols, d , whereby each block has a length of T_{bl} . Both blocks are separated by a training sequence, t_{seq} , with a duration of T_{seq} . The end of the radio block forms a protective time, T_g , which is supposed to compensate for the running time variations because of the different distances of the mobile stations, MS , from the base station, BS . Also

shown in Figure 2 is how an individual data symbol, d , can be transmitted in a pure CDMA procedure - shown on left - or in a pure multi-carrier procedure - shown on the right. In the CDMA procedure each data symbol, d , is splayed with Q code symbols on the broadband, B_u . In the multi-carrier procedure each data symbol, d , is modulated on the Q carrier, whereby the total of the broadbands of the carrier gives the broadband, B_u . In both cases the duration the transmission of the data symbol provides the symbol duration, T_s . Thus the radio communication system is constructed as a TDMA/CDMA mobile radio system in which the data symbols, d , of several communication links can be transmitted in the frequency channels formed by the time slots, whereby the information from various links can be differentiated according to a fine structure individual for each link, for example by splaying the data symbols.

In a combination of the TDMA/CDMA mobile radio system with the OFDMA multi-carrier procedure, optimal frequency resources for all communication links overseen by a base station can be allocated according to the invention with the help of a flexible referral of several sub-carriers or a segment of the frequency spectrum defined thereby. That is especially advantageous for applications with low power requirements - e.g., micro-cell systems - or for TDD

applications (Time Division Duplex) or for applications with higher data rates - e.g., for indoor systems, wireless systems or for applications with low movement speeds. By means of the improved frequency resource referral procedure (smart frequency hopping approach) according to the invention, interferences, especially the critical inter-cell interference and the inter-symbol interferences, are considered and at least reduced or compensated for. That is therefore of significance, since for almost all radio communication systems it is a typical characteristic, that they are limited in power downlink which is even reinforced by interference.

Figure 3 shows the information flow across the radio interface for the allocation of the frequency resources to

/7

the mobile stations, MS, by the base station. Instead of /4 a base station, BS, a base station control, BSC, can control the allocation but the base station, BS, always communicates through the air with the mobile stations, MS. In an initial step (1) the mobile stations, MS, receive in a parallel manner all sub-carriers, ω_c , in the time slot, t_s , assigned to them. For each sub-carrier, ω_c , the mobile station checks as a second step (2), whether an amplitude modulation is present in the data symbols transmitted in

the time slot, ts , and thus has a measurement result about the quality of the respective sub-carrier, oc . It forms an average value from the results of the check for all sub-carriers belonging to a selected segment which results in a quality value for the entire segment. It can perform that for several segments - preferably in a parallel manner. Each mobile station, MS , determines in another step (3) according to the knowledge of the quality of the various segments at least one suitable, preferred segment, for example segment Sx or Sa or Sm .

(1) In another step (4) the mobile station, MS , sends via the radio interface to the base station, BS , its priority lists, $PL1 \dots PL3$, with the information about several preferred, suitable segments, i.e., about segments Sx , Sy , Sz or Sa , Sb , Sc or Sm , Sn , So for which a sequence of suitability is determined by the mobile station, MS .

16 In the next step (5) the base station, BS , evaluates the incoming priority lists, $PL1 \dots PL3$, with the information about the desired segments and decides - if necessary in a return conversation with the base station control, BSC - which segment was allocated to the respective mobile station, MS . In the example cited, the base station, BS , assigns the segments, Sx , Sa and Sm which were selected as the most suitable segments by the mobile

station to the three mobile stations, MS. For the case where the desired segment can not be allocated, one of the other segments is selected which were alternatively chosen by the mobile station, Ms. In a step (6) information about the allocated segments, S_x , S_a , and S_m is sent via the radio interface to the mobile stations, MS, which then use the received new frequency resources in the frequency spectrum for their individual communication links. To monitor as wide a frequency spectrum as possible the mobile stations, MS, each have a broadband receiver which is the case when using the OFDMA multi-carrier procedure. The point in time and thus the speed of the change of the allocation of radio resources and frequency resources can depend on the transmission conditions and/or the capacity utilization of a radio cell. It is basically possible per second in a relative frequency corresponding to the number of transmitted TDMA frames. In a mobile radio system based on a GSM standard, approximately 217 frames, for example, are transmitted per second.

Figure 4 shows a schematic depiction of the amplitude modulation of the transmitted data symbols on a OFDMA sub-carrier to measure the quality of the segments through each mobile station. By converting possibly appearing interferences or noises into an amplitude modulation from

data symbol to data symbol, the quality of the individual sub-carriers and thus the entire segment can be measured across all associated sub-carriers in a simple but effective manner. For every transmitted data symbol in a time slot an FFT signal processing is performed and the signal processing is continued in a carrier-selective

8

manner for the sub-carriers of the segment. There thus arises a resulting signal, r_s , from a wanted signal, s_s , by means of an interference signal or a noise signal, i_s , with a definite amplitude which lies between a maximum amplitude, A_{max} , and a minimum amplitude, A_{min} . If interference or noise is present, the amplitudes of the individual data symbols on a certain sub-carrier vary from data symbol to data symbol. If there is no interference or noise, the amplitudes of all data symbols manifest the same value. Relative deviations of the amplitudes of the data symbols can thereby be most easily determined, so that the absolute amplitude difference from data symbol to data symbol can be added up and the addition result can be normalized with the average amplitude of all data symbols transmitted to a predetermined sub-carrier. In this example the quality results of all 40 sub-carriers of the segment, S_x , are determined and an appropriate quality value is

determined for the segment, Sx. This is also done for a variety of other segments and a number of segments of the best quality for a communication link is determined.

A mobile station, MS, to support the procedure of the invention and the radio communication system is shown in Figure 5, while Figure 6 shows a corresponding base station, BS, or base station control, BSC. Only depicted are the means and devices essential for the object of the invention.

The mobile station, MS, manifests a control means, MSE, with a storage device, MSP, and an FFT device, FFT, a means of modulation, MOD, or a means of demodulation, DEM, and a transmitter/receiver, MHF.

Data symbols, d, of the participating signals are transmitted in both a down-link and up-link direction. For the transmission in an up-link direction they are processed by a control means, MSE, and are sent to the modulation means, MOD, for transmission. On the other hand, in the down-link direction data symbols, d, are received by the transmitter/receiver, MHF, are processed by the means of demodulation, DEM, and are sent on to the control means, MSE. Data modulation, error protection, packaging, etc. are performed in a part of the means of modulation, MOD. In addition, the data symbols, d, of a radio block are splayed

in a portion of the modulation means, MOD, corresponding to a combination of a TDMA and a CDMA procedure to achieve the fine structure specific to the individual link for the differentiation of the participating signals in a time slot. After an analog/digital conversion the radio blocks are amplified in the transmitter/receiver, MHF, and sent via the radio interface to the base station.

In the down-link direction the transmitter/receiver means, MHF, receives all sub-carriers, oc, from the air in the time slot allocated to the mobile station, MS, - see step (1) in Figure 3. The control means, MSE, is informed by the sub-carriers, oc, and conducts a measurement of the quality of various segments corresponding to the above variations. The control means, MSE, determines the suitable segments, S ..., preferred for its own communication link, enters them in the priority list, and schedules the transmitter/receiver to transmit appropriate information through the air to the base station - see step (4) in Figure 3.

The transmitter/receiver, MHF, also receives the information in the down-link direction via the individual segment, S ..., allocated by the base station - but at a later point in time after an evaluation of the transmitted

segments of all mobile station by the base station - see step (6) in Figure 3. In keeping with the allocated /9 frequency resources the control means, MSE, makes a /5 change of the radio parameters in the radio cell for the mobile station, MS.

At the same time because of the improved allocation procedure corresponding to the needs of the individual mobile stations, MS, the special transmission conditions (no CDMA or a multi-carrier procedure only within a certain bandwidth) and special data rates can be requested.

The device according to Figure 6 - designed as a base station, BS, or a base station control, BSC - manifests a control means, BSE, with a memory means, BSP, and an FFT device, FFT, a modulation means, MOD, or a demodulation means, DEM, and a transmitter/receiver, BHF. The transmitter/receiver, BHF, is scheduled by the control means, BSE, to transmit through the air the sub-carriers, ω_c , in the down-link direction to the mobile stations. In the opposite direction the transmitter/receiver, BHF, receives information via the segments, $S \dots$, determined by the mobile stations and sends it to the control means, BSE. Based on the evaluation of the totality of the incoming information, the control means, BSE, assigns a segment, $S \dots$, to each of its mobile stations and schedules the

transmitter/receiver, BHF, to transmit appropriate information through the air to the respective mobile station.

The change of the segments of the frequency spectrum also considers the transmission conditions (strong impediments and interference) and the utilization capacity of the radio resources (time slots, frequencies, splay code) in the radio cell. These conditions are signaled to the control means, BSE, by the base station controller, BSC, or the Operation and Maintenance Center, OMC. Then the control means, BSE, selects the sub-carriers for the definition of the segment according to the quality characteristics for each communication link.

The signal processing when using the OFDMA multi-carrier procedure by the FFT device as well as the modulation means, MOD, or the demodulation means, DEM, operates in the base station, BS, in the same manner as in the mobile station, MS, so that the above variants apply according to Figure 5. Stored in the memory device, BSP, are, among other things, the priority lists with the preferred suitable segments coming from the mobile stations.

To achieve as simple as possible a synchronization in relation to time and frequency, an initial synchronization

step is performed in which symbols with half transmission rates are sent, so that the transmitted symbols can be securely received in a time window, even with completely unsynchronized conditions. With the use of micro-cells only, a synchronization of the mobile stations to the base station is required.

A base station code can be formed to identify the base station, whereby the phases of the data symbols transmitted between at least two adjacent sub-carriers at a first position in the radio block are used. Preferably these are two sub-carriers which lie in the center of a data stream with several sub-carriers. Thus the phase 0 degrees is assigned to the first data symbol on the sub-carrier with the lower frequency. The phase of the first data symbol of the adjacent sub-carrier with the higher frequency forms the base station code, i.e., with the values 0 degrees, 90 degrees, 180 degrees and 270 degrees. The phases of the first symbols of both adjacent sub-carriers can also be used as a phase reference to detect information on all sub-carriers.

From the above remarks it can be seen, that the

10

procedure of the invention is especially suitable for use in future radio communications systems, like the UMTS

(Universal Mobile Communication System) or the FPLMTS
(Future Public Land Mobile Telecommunication System).

Patent Claims

1. Procedure to allocate the radio resources of a radio interface of a radio communications system, whereby

- data symbols (d) are transmitted in time slots (ts) across a radio interface between a base station (BS) and several mobile stations (MS) overseen by the base station (BS), and ✓

- an OFDMA multi-carrier procedure is used to transmit the data symbols (d) which allocates to the mobile stations (MS) a number of sub-carriers (oc) and thus a segment (S ...) of a frequency spectrum for the communication link between the base station (BS) and the mobile station (MS),

with the following procedural steps: 16

- measurement of the quality of various segments (S ...) the frequency spectrum by each mobile station (MS),
- determination by each mobile station (MS) of at least one suitable segment (Sx ... Sa ... Sm...) preferred for its own communication link and transmission of appropriate information to the base station (BS),
- evaluation of the information received from the mobile stations (MS) by the base station (BS) and 23

assignment of a segment (Sx, Sa, Sm) for the
respective communication link to each mobile station
(MS) depending on the evaluation, as well as
- transmission of information about the assigned
segment (Sx, Sa, Sm) to each mobile station (MS) by
the base station (BS).

assigned

2. Procedure according to Claim 1 in which at least two
mobile station (MS) are assigned segments (Sx, Sa) of the
frequency spectrum by the base station whose bandwidths
differ from each other.

3. Procedure according to Claim 1 or 2 in which the mobile
station (MS) is assigned a different number of time slots
(ts) by the base station (BS) for the transmission of data
symbols (d) in the assigned segments.

priority list
4. Procedure according to one of the previous claims in
which a priority list (PL1, PL2, PL3) is sent from the
mobile station (MS) to the base station (BS) which contains
information about a best suited segment (Sx, Sa, Sm) for
its own communication link, as well as other suitable
segments (Sy, Sz; Sb, Sc; Sn, So) preferred for its own
communication link.

5. Procedure according to one of the previous claims in
which a predetermined number of sub-carriers (oc) is used

by the base station (BS) in each time slot on which a predetermined number of data symbols (d) is transmitted.

6. Procedure according to one of the previous claims in which the number of allocated sub-carriers (oc) in a time slot (ts) for each mobile station (MS) can be variably adjusted by the base station.

7. Procedure according to one of the previous claims in

which in order to measure the quality of the segments /6 (S ...) of the frequency spectrum by the mobile station

- all sub-carriers (oc) are received in the time slot allocated to it,
- a check is made for each sub-carrier (oc), whether an amplitude modulation of the data symbols (d) transmitted in the time slot is present and an average value is formed from the results of the test for all sub-carriers (oc) belonging to the respective segment (S ...).

8. Procedure according to Claim 7 in which relative deviations of the amplitudes of the data symbols (d) are so determined, that the absolute amplitude difference from data symbol to data symbol is added up and the addition result is normalized with the average amplitude of all data symbols transmitted on a predetermined sub-carrier (oc).

9. Procedure according to Claim 7 or 8 in which several segments (e.g., Sx, Sy, Sz) of the best quality are determined by the mobile station (MS) and are numbered in a priority list (e.g., PL1) corresponding to increasing amplitude modulation.

10. Procedure according to one of Claims 7 to 9 in which an amplitude modulation is then determined, when the amplitudes of the data symbols (d) transmitted on a certain sub-carrier (oc) differ from data symbol to data symbol because of interferences or noises.

11. Procedure according to one of the previous claims in which the radio communication system is designed as a TDMA/CDMA mobile radio system in which data symbols (d) of several communication links can be simultaneously transmitted in frequency channels formed by time slots, whereby the information of various communication links can differ according to the fine structure of individual links.

12. Radio communication system to allocate radio resources of a radio interface, whereby

- data symbols (d) are transmitted in time slots (ts) across a radio interface between a base station (BS) and several mobile stations (MS) overseen by the base station,

- an OFDMA multi-carrier procedure is used to transmit the data symbols (d) which allocates to the mobile stations (MS) a number of sub-carriers (oc) and thus a segment (S ...) of a frequency spectrum for the communication link between the base station (BS) and the mobile station (MS),

with

- a control means (MSE) in each mobile station (MS) to measure the quality of various segments (S ...) of the frequency spectrum and to determine at least one suitable segment (Sx ... Sa ... Sm...) preferred for its own communication link,

- a transmitter (MHF) in each mobile station (MS) to transmit appropriate information to the base station (BS),

- a control means (BSE) in each base station (BS) to evaluate the information received from the mobile stations (MS) and to allocate a segment (Sx, Sa, Sm) for the respective communication link to each mobile

station (MS) depending on the evaluation, as well as

- a transmitter (HF) in each base station to transmit information about the allocated segments (Sx, Sa, Sm) to each base station.

13. Radio communication system according to Claim 12 with a mobile station which manifests

- a control means (MSE) to measure the quality of various segments (S ...) of the frequency spectrum and to determine at least one suitable segment (Sx, Sa, Sm) preferred for its own communication link, and
- a transmitter (MHF) to transmit appropriate information to the base station (BS).

14. Radio communication system according to Claim 12 or 13 with a device which manifests

- a control means (MSE) to evaluate the information received from the mobile stations (MS) and to allocate a segment (Sx, Sa, Sm) for the communication link to each mobile station (MS) depending on the evaluation, as well as
- a transmitter (BHF) to transmit information about the allocated segments (Sx, Sa, Sm) to each mobile station (MS).

15. Radio communication system according to Claim 14 in which the control means (BSE) performs the evaluation of the information received from the mobile stations and the allocation of the segments (Sx, Sa, Sm) for the respective communication links to the mobile stations (MS) corresponding to the transmission conditions and/or the

utilization capacity of a radio cell according to input data from a device (BSC, OMC) for radio resource management.

16. Radio communication system according to Claim 14 or 15 in which the device is constructed as a part of the base station (BS).

17. Radio communication system according to Claim 14 or 15 in which the device is constructed as a part of the base station control (BSC).

FIG 1

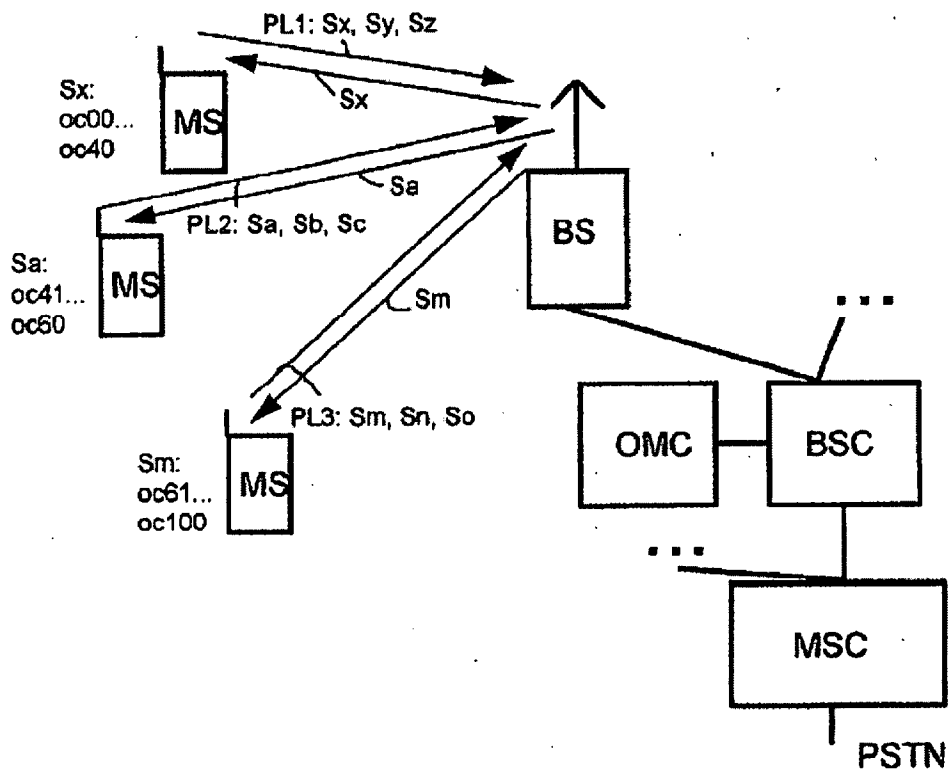


FIG 4

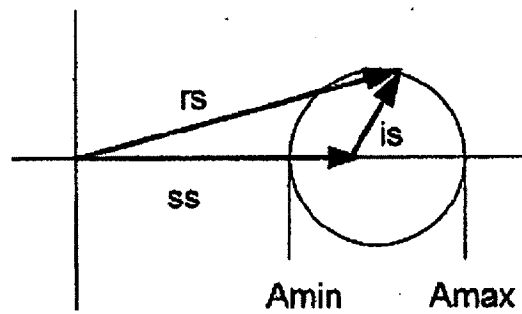
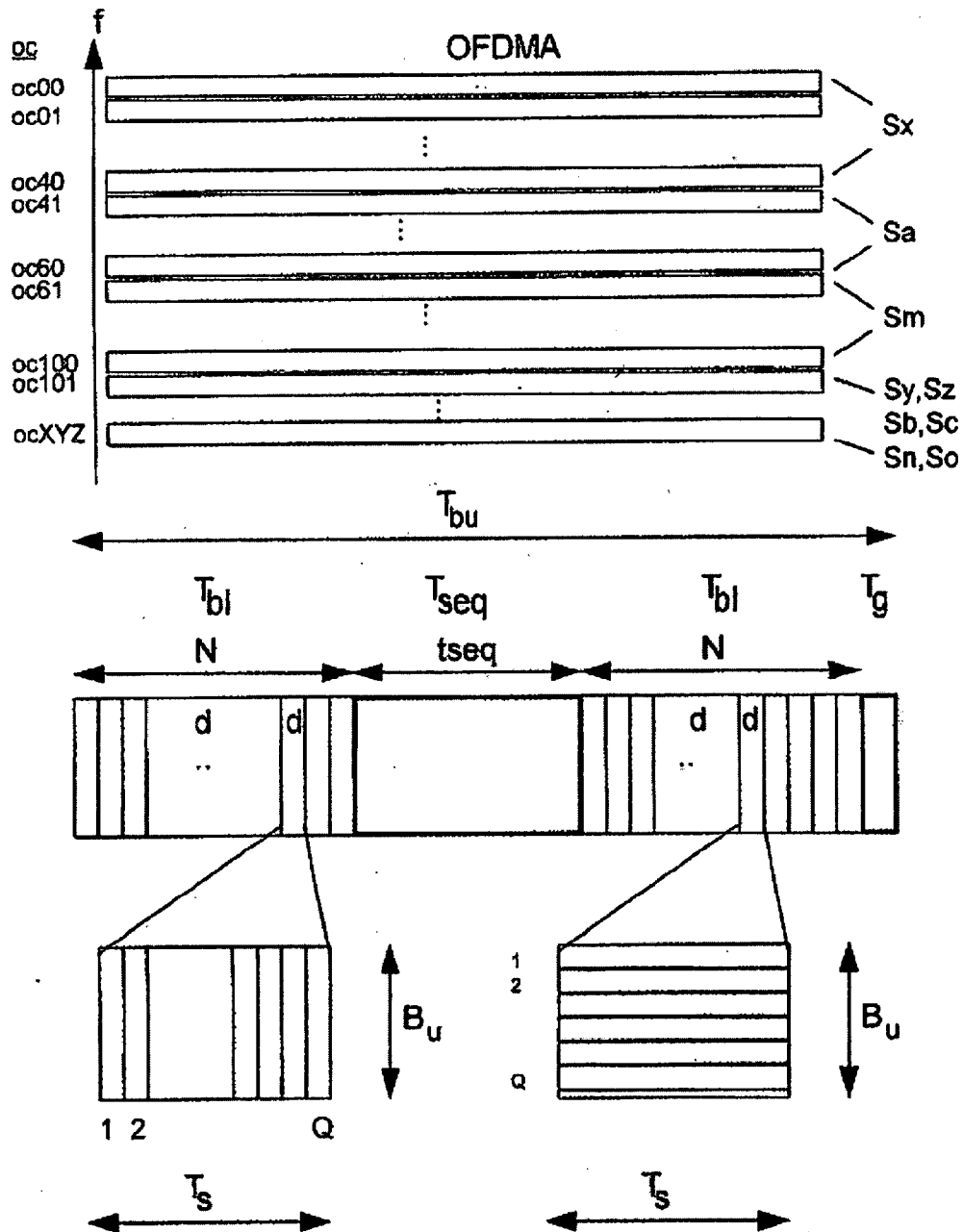


FIG 2



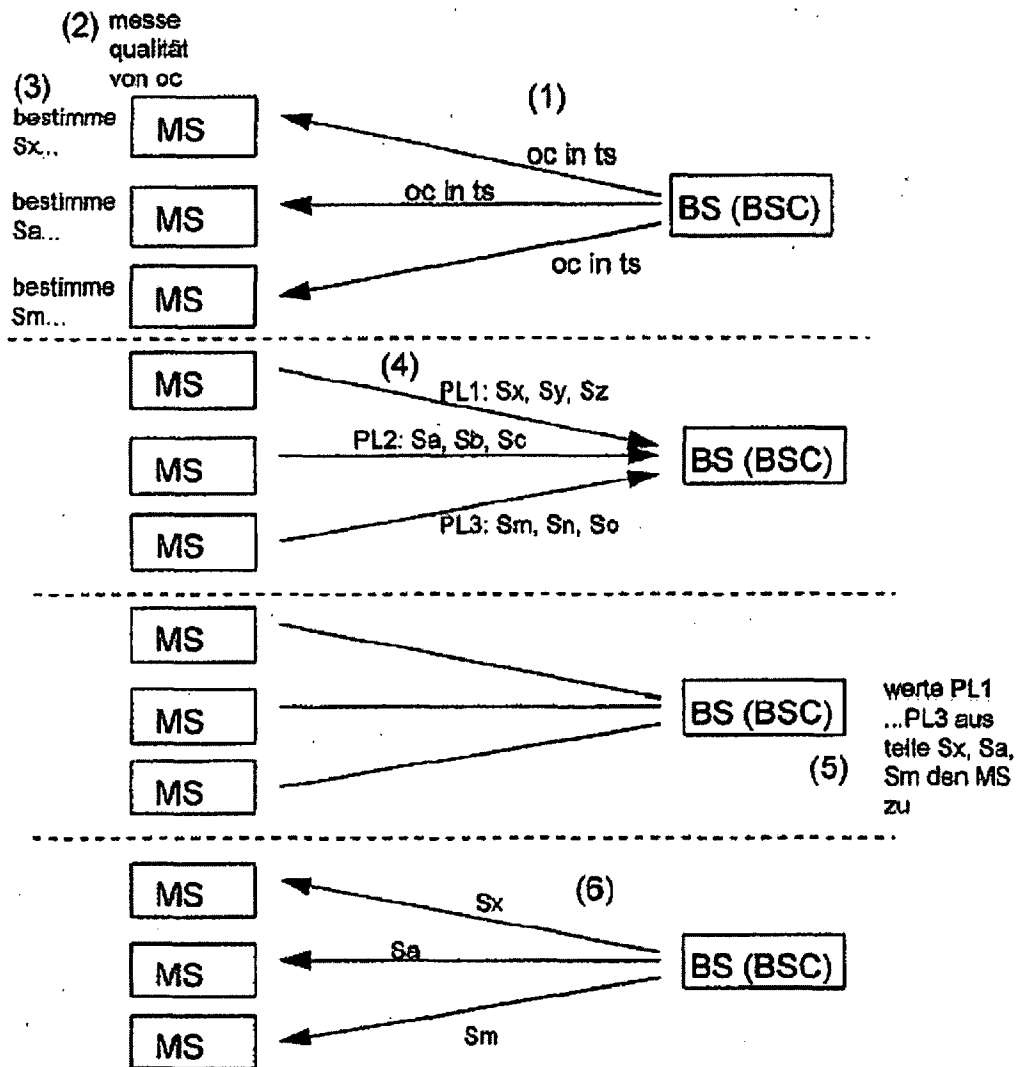


FIG 3

FIG 5

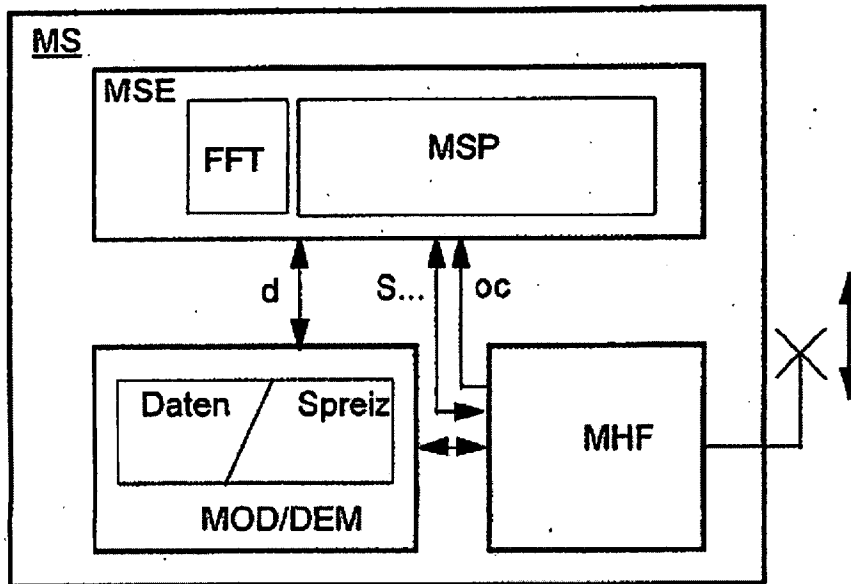


FIG 6

