

**UNITED STATES PATENT AND TRADEMARK OFFICE**

---

**BEFORE THE PATENT TRIAL AND APPEAL BOARD**

---

COMMSCOPE, INC.,  
Petitioner

v.

TQ DELTA, LLC,  
Patent Owner

---

U.S. Patent No. 9,485,055  
Issue Date: November 1, 2016  
Title: PACKET RETRANSMISSION AND MEMORY SHARING  
Case No. IPR2022-00833

---

**DECLARATION OF BRUCE MCNAIR IN SUPPORT OF PETITION FOR *INTER*  
*PARTES* REVIEW OF U.S. PATENT NO. 9,485,055**

Mail Stop PATENT BOARD  
Patent Trial and Appeal Board  
United States Patent and Trademark Office  
P.O. Box 1450  
Alexandria, VA 22313-1450

## TABLE OF CONTENTS

	Page
<b>I. INTRODUCTION AND QUALIFICATIONS</b> .....	1
<b>A. INTRODUCTION</b> .....	1
<b>B. QUALIFICATIONS AND EXPERIENCE</b> .....	2
1. EDUCATION .....	2
2. RELEVANT INDUSTRY EXPERIENCE.....	2
3. PUBLICATIONS.....	4
4. PRIOR EXPERT TESTIMONY .....	5
<b>C. MATERIALS CONSIDERED</b> .....	5
<b>II. LEGAL PRINCIPLES</b> .....	8
<b>A. PRIOR ART</b> .....	8
<b>B. CLAIM CONSTRUCTION</b> .....	9
<b>C. ANTICIPATION</b> .....	11
<b>D. OBVIOUSNESS</b> .....	12
1. MOTIVATION TO COMBINE .....	15
2. SECONDARY CONSIDERATIONS .....	17
<b>III. LEVEL OF ORDINARY SKILL IN THE ART</b> .....	18
<b>IV. THE '055 PATENT</b> .....	20
<b>A. TECHNOLOGY BACKGROUND</b> .....	20
1. DATA TRANSMISSION PROTOCOLS AND PACKET STRUCTURE .....	20
2. NOISE IN DATA TRANSMISSION.....	25
3. SPEED AND ACCURACY IN DATA TRANSMISSION .....	26
4. RETRANSMISSION .....	29
5. QOS IN DATA TRANSMISSION PROTOCOLS .....	30

6.	DSL AND ADSL .....	35
<b>B.</b>	OVERVIEW OF THE '055 PATENT .....	40
<b>C.</b>	PROSECUTION HISTORY .....	45
<b>D.</b>	THE CHALLENGED CLAIMS .....	51
<b>V.</b>	CLAIM CONSTRUCTION .....	54
<b>VI.</b>	APPLICATION OF THE PRIOR ART TO THE CHALLENGED CLAIMS .....	55
<b>A.</b>	BRIEF SUMMARY OF PRIOR ART .....	55
1.	U.S. PATENT APPLICATION PUBLICATION NO. 2005/0036497 TO KAWAKAMI ("KAWAKAMI") (EX. 1004) .....	55
2.	REYNDERS, D., WRIGHT, E., "PRACTICAL TCP/IP AND ETHERNET NETWORKING" (2003) ("REYNDERS") (EX. 1005) .....	61
3.	RFC 791, "INTERNET PROTOCOL," SEPTEMBER 1981 (EX. 1006).....	75
4.	RFC 793, "TRANSMISSION CONTROL PROTOCOL," SEPTEMBER 1981 (EX. 1007) .....	78
5.	RFC 768, "USER DATAGRAM PROTOCOL," AUGUST 28, 1980 (EX. 1008) .....	83
<b>B.</b>	GROUND 1: CLAIMS 1, 5, 10, 11, 15, AND 20 ARE UNPATENTABLE AS OBVIOUS UNDER 35 U.S.C. §103(A) IN VIEW OF KAWAKAMI (EX. 1004).....	85
1.	INDEPENDENT CLAIM 1 .....	85
2.	INDEPENDENT CLAIM 11 .....	97
3.	DEPENDENT CLAIMS 5 AND 15 .....	99
4.	DEPENDENT CLAIMS 10 AND 20 .....	100
<b>C.</b>	GROUND 2: CLAIMS 1, 4, 5, 7, 9, 10, 11, 14, 15, 17, 19, AND 20 ARE UNPATENTABLE AS OBVIOUS UNDER 35 U.S.C. §103(A) BY REYNDERS (EX. 1005).....	101

1.	INDEPENDENT CLAIM 1 .....	101
2.	INDEPENDENT CLAIM 11 .....	115
3.	DEPENDENT CLAIMS 4 AND 14 .....	117
4.	DEPENDENT CLAIMS 5 AND 15 .....	119
5.	DEPENDENT CLAIMS 7 AND 17 .....	122
6.	DEPENDENT CLAIMS 9 AND 19 .....	123
7.	DEPENDENT CLAIMS 10 AND 20 .....	124
<b>D.</b>	GROUND 3: CLAIMS 1, 4, 5, 7, 9, 10, 11, 14, 15, 17, 19, AND 20 ARE UNPATENTABLE AS OBVIOUS UNDER 35 U.S.C. §103(A) OVER RFC 791 (EX. 1006), RFC 793 (EX. 1007), AND RFC 768 (EX. 1008). ....	125
1.	MOTIVATION TO COMBINE .....	125
2.	INDEPENDENT CLAIM 1 .....	127
3.	INDEPENDENT CLAIM 11 .....	133
4.	DEPENDENT CLAIMS 4 AND 14 .....	136
5.	DEPENDENT CLAIMS 5 AND 15 .....	137
6.	DEPENDENT CLAIMS 7 AND 17 .....	139
7.	DEPENDENT CLAIMS 9 AND 19 .....	140
8.	DEPENDENT CLAIMS 10 AND 20 .....	141
<b>VII.</b>	CONCLUSION.....	142

I, Bruce McNair, declare as follows:

## **I. INTRODUCTION AND QUALIFICATIONS**

### **A. Introduction**

1. I am an independent consultant.
2. I have been retained by Goodwin Procter LLP, counsel for CommScope Inc. (“CommScope”), as a technical expert witness in connection with the petition for *inter partes* review of U.S. Patent No. 9,485,055 (“’055 patent”). I understand that the ’055 patent claims priority to a provisional application filed on April 12, 2006. For purposes of my analysis herein, I have assumed this date is the priority date.
3. I have been asked by CommScope to offer opinions regarding the ’055 patent, including the patentability of the claims in view of certain prior art references and the knowledge of a person having ordinary skill in the art. This Declaration sets forth the opinions I have reached to date regarding these matters.
4. In preparing this Declaration, I have reviewed the ’055 patent, its prosecution history, and each of the documents I reference herein. In reaching my opinions, I have relied upon my experience in the field and have also considered the viewpoint of a person having ordinary skill in the art at the time of the ’055 patent’s priority date. As explained below, I am familiar with the level of skill of a

person having ordinary skill in the art regarding the technology at issue as of that time frame.

5. I am receiving my customary hourly rate for my services. I do not have any personal or financial stake or interest in the outcome of the present proceeding, and my compensation is not dependent on the outcome of this IPR and in no way affects the substance of my statements in this declaration.

## **B. Qualifications and Experience**

6. My qualifications for forming the opinions set forth in this Declaration are summarized here and explained in more detail in my curriculum vitae, which I have attached to my Declaration. The following sections recite the most relevant aspects of my educational, professional, and technical background.

### **1. Education**

7. I received my Bachelors of Engineering (Electrical) from Stevens Institute of Technology in 1971 and my Masters of Electrical Engineering from Stevens in 1974. I have taken numerous PhD-level courses in Electrical Engineering, Computer Engineering and Computer Science at Stevens, as well.

### **2. Relevant Industry Experience**

8. I was employed by the US Army Electronics Command at Fort Monmouth, NJ, from 1971 to 1973 and 1974 to 1978 where I worked with voice, data and wireless communications systems.

9. In 1973, I was employed by ITT Defense Communications Division in Nutley, NJ, where I designed digital hardware and computer software to investigate signal processing of speech signals and transmission of satellite communications signals using advanced forward error correction schemes.

10. From 1978 to 2002, I was employed by AT&T Bell Laboratories and AT&T Laboratories at various New Jersey locations. My work there involved public data networks, high-speed digital communications over analog networks, speech processing, network security, and wireless communications. Several of my positions were closely associated with the subject matter of asserted patents. In particular, while I was in the Bell Labs Data Services Center in the late 1970s, I participated in the design of the Advanced Communications Service, a network very much like today's Internet, built on X.25 and related international standards, rather than the TCP/IP protocol stack that the Internet is based on. While I was in the Bell Labs Data Communications Laboratory in the early 1980s, I worked on high-speed analog modems using techniques that others in the organization later applied to DSL signaling. John Cioffi, one of the inventors of cited prior art was one of the other members of the group I was in. Rich Gitlin, who was the supervisor of that group and later the head of the same department is the recognized inventor of the initial concept of DSL technologies for the local

telephone plant. From 1987 to 1994, I created and supervised the Bell Labs Security and System Reliability Architecture Group. In this role, I investigated network security issues including those created in TCP/IP networks. Later in my AT&T/Bell Labs career (1994-2002) I investigated the use of Orthogonal Frequency Division Multiplexing (OFDM) for wireless communications. OFDM forms the basis for DSL communications although the characteristics of a wireless network environment make communications far more difficult than the relatively benign DSL environment. My research in OFDM for wireless applications included the use of interleaving, forward error correction, synchronization and Reed-Solomon codes. My teaching at Stevens has included several graduate courses that have components that address issues in TCP/IP networks and I have supervised a number of undergraduate senior design projects that have emphasized TCP/IP networking.

### **3. Publications**

11. My list of publications is shown in my CV, listed in Appendix A, but I highlight a few that are closely related to the subject matter of the asserted patents: At VTC00, I presented results from an experimental implementation of



OFDM in a wireless environment<sup>1</sup>. I presented further results for this OFDM system at the Sarnoff Symposium in 2001.<sup>2</sup> Seven more of my papers are also OFDM related.

#### **4. Prior Expert Testimony**

12. In the past four years, I have testified as an expert at deposition or trial as described in my CV, which is attached as Appendix A.

#### **C. Materials Considered**

13. The analysis I provide in this Declaration is based on my education and experience in the field of DSL, as well as the documents I have considered, including the '055 patent (Ex. 1001) and its prosecution history (Ex. 1002) and the other documents that I reference in this Declaration. The '055 patent states on its face that it issued from an application filed on January 20, 2014, as a continuation of Application No. 13/766,059, filed on February 13, 2013, now Pat. No. 8,645,784, which is a continuation of Application No. 12/783,758, filed on May 20, 2010, now Patent No. 8,407,546, which is a continuation of application No. 12/295,828, filed as application No. PCT/US2007/066522 on April 12, 2007, now Patent No. 8,335,956, and also claimed the benefit of U.S. Provisional

<sup>1</sup> B. McNair, L. Cimini, N. Sollenberger, "Performance of an Experimental 384 kb/s 1900 MHz Radio Link in a Wide-Area High-Mobility Environment," Proc. IEEE Vehicular Technology Conference – VTC00, Boston, MA, October 2000.

<sup>2</sup> B. McNair, L. Cimini, "OFDM for High Data Rate, High-Mobility, Wide-Area Wireless Communications," Proc. IEEE Sarnoff Symposium, Princeton, NJ, March 2001.

Applications No. 60/849,650 and 60/792,236, filed on October 5, 2006 and April 12, 2006, respectively. For the purposes of this Declaration, I have assumed that April 12, 2006 is the effective filing date for the '055 patent. I have cited to the following documents in my analysis below:

<i><b>Exhibit #</b></i>	<i><b>Description</b></i>
1001	U.S. Patent No. 9,485,055
1002	Prosecution History of U.S. Patent Application No. 14/159,125
1004	U.S. Patent Application Publication No. 2005/0036497 to Kawakami (“Kawakami”)
1005	Reynders, D. and Wright, E., “Practical TCP/IP and Ethernet Networking,” 2003 (“Reynders”)
1006	RFC 791, “Internet Protocol,” Information Sciences Institute, Sept. 1981 (“RFC 791”)
1007	RFC 793, “Transmission Control Protocol,” Information Sciences Institute, Sept. 1981 (“RFC 793”)
1008	RFC 768, “User Datagram Protocol,” Information Sciences Institute, Aug. 1980 (“RFC 768”)
1009	RFC 790, “Assigned Numbers,” Information Sciences Institute, Sept. 1981 (“RFC 790”)
1010	U.S. Patent Application Publication No. US 2004/0252700 (“Anandakumar”)
1011	U.S. Patent Application Publication No. US 2003/0067903 (“Jorgensen”)

1012	International Patent Application Publication No. WO 01/80558 (“Bastone”)
1013	International Patent Application Publication No. WO 00/45581 (“Oliver”)
1014	RFC 762, “Assigned Numbers,” Information Sciences Institute, Jan. 1980 (“RFC 762”)
1015	Halapoto, I. A., Chowdhry, B. S., Abro, F. R., “Implementation of DSL in Pakistan-Growth, Potential and Bandwidth Impact – A Technical Report,” Mehran University Research Journal of Engineering and Technology, Volume 24, No. 3 (July 2005) (“Halapoto”)
1016	Sutherland, B., “The Alcatel Experience of DSL Deployment, The Institution of Electrical Engineers, 2000 (“Sutherland”)
1017	ITU-T Recommendation G.992.1 (June 1999) (“G.992.1”)
1018	ITU-T Recommendation G.993.1 (June 2004) (“G.993.1”)
1019	ITU-T Recommendation G.992.3 (July 2002) (“G.992.3”)
1020	ATIS ADSL Standard T1.413 Issue 1 (1995) (“T1.413 Issue 1”)
1021	Claim Construction Order, <i>TQ Delta, LLC. v. Adtran, Inc.</i> , No. 1:14-cv-954, Dkt. No. 396 (D. Del. May 15, 2018) (“Claim Construction Order”)
1022	Park, J., Yoon, Y., Lee, S., “An Extended TCP/IP Protocol Over the Local Area Network for DCCS,” IFAC Proceedings Volume 30, Issue 15, pp. 97-104 (July 1997) (“Park”)

1023	Smith, M. A., Ramakrishnan, K. K., “Formal Specification and Verification of Safety and Performance of TCP Selective Acknowledgment,” III/ACM Transactions on Networking, Vol. 10, No. 2, pp. 193-207 (April 2002) (“Smith”)
1024	U.S. Patent No. 7,016,658
1025	U.S. Pat. App. Pub. No. 2006/0039330 (“Hackett”)
1026	Summers, C. K., ADSL Standards, Implementation, and Architecture, CRC Press (1999) (“Summers”)
1027	Texas Instruments TNETD2000C Product Bulletin (1998) (“TNETD2000C Product Bulletin”)

## II. LEGAL PRINCIPLES

14. I am not offering any opinions on the law in this Declaration. For purposes of this Declaration, I have been informed about certain aspects of the law that are relevant to my analysis and opinions, as set forth below.

### A. Prior Art

15. I understand that the prior art to the '055 patent includes patents and printed publications in the relevant art that predate the '055 patent's priority date. As I explained previously, I have assumed for purposes of my analysis that April 12, 2006 is the relevant date for determining what is “prior art.” In other words, I have considered as “prior art” publications and general knowledge in the field publicly available prior to April 12, 2006. I further understand that, for purposes of this proceeding in the United States Patent Trial and Appeal Board, only patents

and documents that have the legal status of a “printed publication” may be cited as prior art.

**B. Claim Construction**

16. I understand that under the applicable legal principles, claim terms are generally given their ordinary and customary meaning, which is the meaning that the term would have had to a person having ordinary skill in the art in question at the time of the invention, i.e., as of the effective filing date of the patent application. I further understand that the person having ordinary skill in the art is deemed to read a claim term not only in the context of the particular claim in which that claim term appears, but also in the context of the entire patent, including the specification and file history.

17. I am informed by counsel that under these legal principles, the patent specification has been described as the best guide to the meaning of a claim term and is thus highly relevant to the interpretation of claim terms. I also understand that the specification usually supplies the best context of understanding the meaning of terms that do not have a customary meaning within the art.

18. I am further informed by counsel that other claims of the patent in question, both asserted and unasserted, can be valuable sources of information as to the meaning of a claim term. Because the claim terms are normally used

consistently throughout the patent, the usage of a term in one claim can often illuminate the meaning of the same term in other claims. Differences among claims can also be a useful guide in understanding the meaning of particular claim terms.

19. I understand that the prosecution history can further inform the meaning of the claim language by demonstrating how the inventors understood the invention and whether the inventors limited the invention during the course of prosecution, making the claim scope narrower than it otherwise would be. Extrinsic evidence may also be consulted in construing the claim terms, such as my experience and expert testimony.

20. I have been informed by counsel that, in IPR proceedings, a claim of a patent shall be construed using the same claim construction standard that would be used to construe the claim in a civil action filed in a U.S. district court (which I understand is called the “Phillips” claim construction standard), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.

21. I understand that some claims are independent, and that these claims are complete by themselves. Other claims refer to these independent claims and are “dependent” from those independent claims. The dependent claims include all of

the limitations of the claims from which they depend.

**C. Anticipation**

22. I understand that to anticipate a patent claim under 35 U.S.C. §102, a single asserted prior art reference must disclose each and every element of the claimed invention, either explicitly, implicitly, or inherently, to a person having ordinary skill in the art. There must be no difference between the claimed invention and the disclosure of the alleged prior art reference as viewed from the perspective of the person having ordinary skill in the art. Also, I understand that in order for a reference to be an anticipating reference, it must describe the claimed subject matter with sufficient clarity to establish that the subject matter existed and that its existence was recognized by persons having ordinary skill in the field of the invention, and must allow a person having ordinary skill in the art to make or perform the claimed subject matter without undue experimentation. In addition, I understand that in order to establish that an element of a claim is “inherent” in the disclosure of an asserted prior art reference, extrinsic evidence (or the evidence outside the four corners of the asserted prior art reference) must make clear that the missing element is necessarily found in the prior art, and that it would be recognized as necessarily present by persons having ordinary skill in the relevant field.

23. In my opinions below, when I say that a person having ordinary skill would understand, readily understand, or recognize that an element or aspect of a claim is disclosed by a reference, I mean that the element or aspect of the claim is disclosed explicitly, implicitly, or inherently to a person having ordinary skill in the art.

**D. Obviousness**

24. I am also informed and understand that a patent claim is unpatentable under 35 U.S.C. §103 if the differences between the claimed invention and the prior art are such that the subject matter as a whole would have been obvious at the time of the invention to a person having ordinary skill in the art to which the subject matter pertains. I understand that obviousness is assessed by considering (i) the scope and content of the prior art, (ii) the differences between the prior art and the claim, (iii) the level of ordinary skill in the art, and (iv) if provided by the patent owner, any secondary indications of non-obviousness (e.g., “secondary considerations” such as commercial success in the marketplace of the claimed invention), to the extent they exist.

25. I understand that whether there are any relevant differences between the prior art and the claimed invention is to be analyzed from the viewpoint of a person having ordinary skill in the art at the time of the invention. For purposes of



this analysis, I was asked to assume the date of the invention was the date of the filing of the earliest-filed provisional application, April 12, 2006. Should other information regarding date of invention become available, I will consider such information. A person having ordinary skill in the art is a hypothetical person who is presumed to be aware of all of the relevant art at the time of the invention. The person having ordinary skill is not an automaton, and may be able to fit together the teachings of multiple patents or publications employing ordinary creativity and the common sense that familiar items may have obvious uses in another context or beyond their primary purposes.

26. In analyzing the relevance of the differences between the claimed invention and the prior art, I understand that I must consider the impact, if any, of such differences on the obviousness or non-obviousness of the invention as a whole, not merely some portion of it. The person having ordinary skill faced with a problem is able to apply his or her experience and ability to solve the problem and also look to any available prior art to help solve the problem.

27. An invention is obvious if a person having ordinary skill in the art, facing the wide range of needs created by developments in the field, would have seen an obvious benefit to the solutions tried by the patent applicant. When there is a design need or market pressure to solve a problem and there is a finite number of

identified, predictable solutions, it would be obvious to a person having ordinary skill to try the known options. If a technique has been used to improve one device, and a person having ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique would have been obvious.

28. I understand that I do not need to look for precise teaching in the prior art directed to the subject matter of the claimed invention. I understand that I may take into account the inferences and creative steps that a person having ordinary skill in the art would have employed in reviewing the prior art at the time of the invention. For example, if the claimed invention combined elements known in the prior art, and the combination yielded results that were predictable to a person having ordinary skill in the art at the time of the invention, then this evidence would make it more likely that the claim was obvious. On the other hand, if the combination of known elements yielded unexpected or unpredictable results, or if the prior art teaches away from combining the known elements, then this evidence would make it less likely that the claim that successfully combined those elements was obvious.

29. In determining whether a claimed invention is unpatentable for obviousness, I understand that I should consider the scope and content of the prior art, the level of ordinary skill in the relevant art, the differences between the

claimed invention and the prior art, and whether the claimed invention would have been obvious to a person having ordinary skill in the art in light of those differences. I understand that hindsight must not be used when comparing the prior art to the invention for obviousness.

30. I further understand that obviousness may be shown by demonstrating that it would have been obvious to modify what is taught in a single piece of prior art to create the patented invention. Obviousness may also be demonstrated by showing that it would have been obvious to combine the teachings of two or more items of prior art.

#### **1. Motivation to Combine**

31. I understand that a claimed invention may be obvious if some teaching, suggestion, or motivation exists that would have led a person having ordinary skill in the art to combine the disclosures of two or more references. I also understand that this suggestion or motivation may come from sources such as explicit statements in the prior art, or from the knowledge of a person having ordinary skill in the art. Alternatively, any need or problem known in the field at the time and addressed by the patent may provide a reason for combining elements of the prior art. I also understand that when there is a design need or market pressure, and there is a finite number of predictable solutions, a person having

ordinary skill may be motivated to apply both his skill and common sense in trying to combine the known options in order to solve the problem.

32. In determining whether a piece of prior art could have been combined with other prior art or with other information within the knowledge of a person having ordinary skill in the art, the following are examples of approaches and rationales that may be considered:

- Combining prior art elements according to known methods to yield predictable results;
- Simple substitution of one known element for another to obtain predictable results;
- Use of a known technique to improve similar devices (methods, or products) in the same way;
- Applying a known technique to a known device (method, or product) ready for improvement to yield predictable results;
- Applying a technique or approach that would have been “obvious to try” (choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success);
- Known work in one field of endeavor that may prompt variations of it for use in either the same field or a different one based on design incentives or

other market forces if the variations would have been predictable to a person having ordinary skill in the art; or

- Some teaching, suggestion, or motivation in the prior art that would have led a person having ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

## **2. Secondary Considerations**

33. I understand that certain objective factors, sometimes known as “secondary considerations,” may also be taken into account in determining whether a claimed invention would have been obvious. In most instances, these secondary considerations of non-obviousness are raised by the patentee. In that context, the patentee argues that an invention would not have been obvious in view of these considerations, which include: (a) commercial success of a product due to the merits of the claimed invention; (b) a long-felt but unsatisfied need for the invention; (c) failure of others to find the solution provided by the claimed invention; (d) deliberate copying of the invention by others; (e) unexpected results achieved by the invention; (f) praise of the invention by others skilled in the art; (g) lack of independent simultaneous invention within a comparatively short space of time; (h) teaching away from the invention in the prior art. I also understand that these objective indications are only relevant to obviousness if there is a connection,

or nexus, between them and the invention covered by the patent claims.

34. I understand that certain “secondary considerations,” such as independent invention by others within a comparatively short space of time, indicate obviousness.

35. I also understand that secondary considerations of non-obviousness are inadequate to overcome a strong showing on the primary considerations of obviousness. For example, where the invention represents no more than the predictable use of prior art elements according to their established functions, the secondary considerations are inadequate to establish non-obviousness.

### **III. LEVEL OF ORDINARY SKILL IN THE ART**

36. I understand that an assessment of claims of the '055 patent should be undertaken from the perspective of a person having ordinary skill in the art as of the earliest claimed priority date, which I understand is April 12, 2006. I have also been advised that to determine the appropriate level of a person having ordinary skill in the art, the following factors may be considered: (1) the types of problems encountered by those working in the field and prior art solutions thereto; (2) the sophistication of the technology in question, and the rapidity with which innovations occur in the field; (3) the educational level of active workers in the field; and (4) the educational level of the inventor.

37. In my opinion, a person having ordinary skill in the art at the time of the alleged invention of the '055 patent in 2006 would have had a bachelor's degree in electrical or computer engineering, or the equivalent, and at least 5-6 years of experience in electrical or computer engineering; a Master's degree in electrical or computer engineering, or the equivalent, and at least 2-3 years of experience in electrical or computer engineering; or a Ph.D. in electrical or computer engineering, or the equivalent, with at least 1-2 years of experience in electrical or computer engineering.

38. My opinions regarding the level of ordinary skill in the art are based on, among other things, my more than 10 years of experience in working in the development and standardization of DSL-related technologies, more than 40 years experience in data networking, including TCP/IP networks, my understanding of the basic qualifications that would be relevant to an engineer or scientist tasked with investigating methods and systems in the relevant area of DSL, my knowledge and experience with the capabilities of DSL systems by 2006, and my familiarity with the backgrounds of colleagues working in the field, both past and present. Although my qualifications and experience exceed those of the hypothetical person having ordinary skill in the art defined above, my analysis and opinions regarding the '055 patent have been based on the perspective of a person

having ordinary skill in the art as of April 12, 2006.

#### **IV. THE '055 PATENT**

##### **A. Technology Background**

39. Below, I provide a brief summary of the technology and the state of the art as of the priority date of the '055 patent as context for understanding the disclosure and claims of the '055 patent and how it compares to the prior art.

40. The '055 patent relates to communication systems, with a focus on packet retransmission, and mentions the use of its methods in the context of systems using multicarrier modulation. *See* '055 patent, 1:28-43, 8:66-9:12. Multicarrier modulation includes discrete multi-tone (DMT) modulation and orthogonal frequency division multiplexing (OFDM), among others. Multicarrier modulation was well known and used in commercial products before the priority date of the '055 patent. For example, by 1995, multicarrier modulation communication systems were standardized for and used in digital subscriber line (DSL) applications for two-way communications over telephone lines, and DMT techniques were used in wireline analog modems by the 1980s.

##### **1. Data Transmission Protocols and Packet Structure**

41. In many transmission protocols as of April 12, 2006, data was not transmitted as a raw stream of bits—it was broken into units of data with delineated structures, often referred to as packets. The structure and contents of

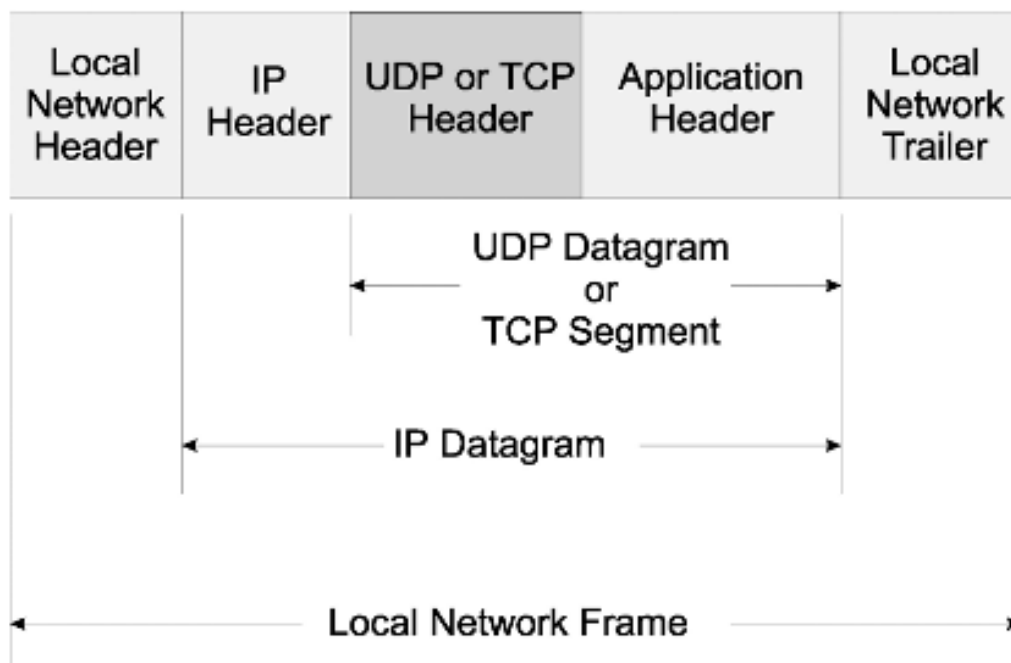


each packet were generally governed by industry-wide standards for a particular transmission format.

42. The foundational technical specifications for the Internet are published by the technical development and standards-setting bodies for the Internet—most importantly, the Internet Engineering Task Force (“IETF”). The IETF maintains and publishes a set of memoranda called RFCs (originally, “Requests for Comments”), some of which are informational or experimental, and some of which are ultimately adopted by the IETF as Internet Standards. *See* IETF, “RFCs,” available at <https://www.ietf.org/standards/rfcs/>. These RFCs, the first of which was written in 1969, describe the core protocols and standards for the Internet.

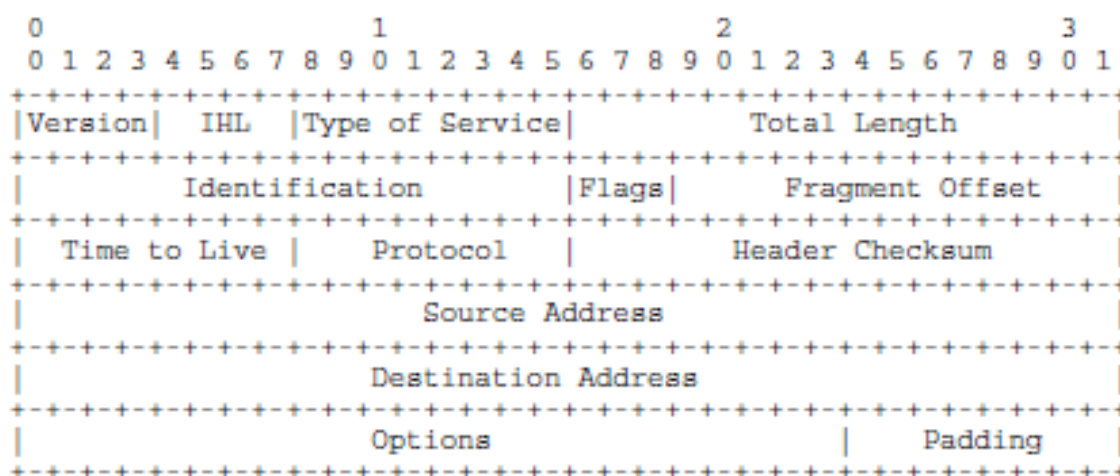
43. Transmission protocols often use the open systems interconnection (“OSI”) model, which “breaks data communication down into a manageable hierarchy of seven layers,” each of which “has a defined purpose and interfaces with the layers above it and below it.” Reynders, D., Wright, E., *Practical TCP/IP and Ethernet Networking* (2003) (“Reynders”) (Ex. 1005), 21. An alternative framework is the ARPA model, which abstracts the communications infrastructure into only four layers, but is conceptually similar otherwise to the OSI model. *Id.*, 75.

44. In addition to the raw data itself, packets commonly contained “headers”—additional bits at the start of the packet that provided information to the data transmission system about the packet, which were often used to convey information between layers. Packets generally contain multiple headers, one added by each layer of a transmission protocol, which allows peer layers across sites to communicate with one another. Reynders, 23-24. For example, a packet transmitted using a TCP/IP protocol would contain multiple layers of headers, including an IP header, and a TCP or UDP header, in addition to the application data being sent. *See, e.g.,* Reynders, 261:



Reynders, Fig. 18.3 (“Typical structure of Ethernet, TCP/IP and application header”).

45. The specific information contained in each layer of headers was governed by the standards for that protocol. For example, RFC 791 specifies that an IP header contains thirteen fields—Version, Length, Type of Service, Total Length, Identification, Flags, Fragment Offset, Time To Live, Protocol, Header Checksum, Source IP Address, Destination IP Address, and Options:



Example Internet Datagram Header

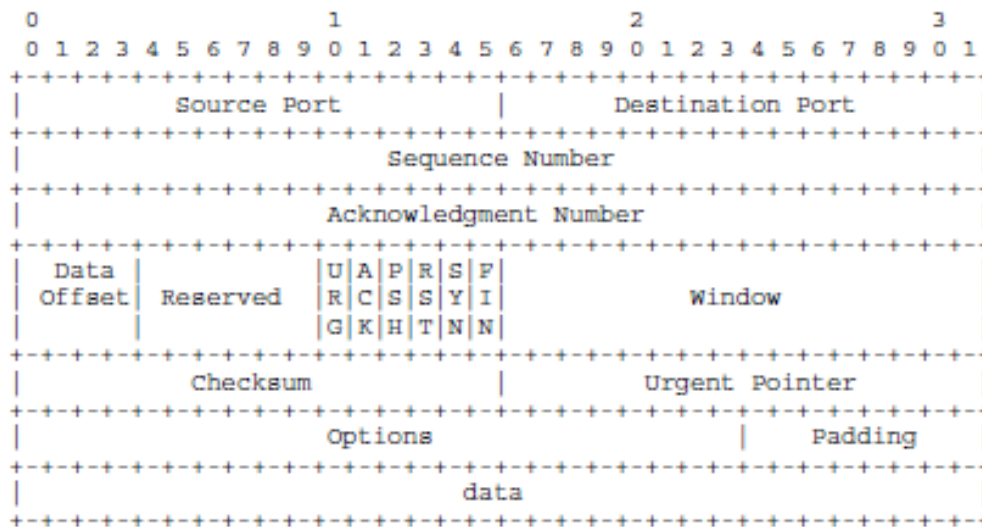
Figure 4.

RFC 791, “Internet Protocol,” Information Sciences Institute, Sept. 1981 (“RFC 791”) (Ex. 1006), Fig. 4.

46. One important piece of information that was frequently added to headers was a sequence number identifying the data unit, each of which would be numbered sequentially. The sequence number allowed the transmitting and receiving systems to identify each packet if needed. It also allowed the receiving system to confirm whether all expected packets had been received—for instance, if

incoming packets were numbered 1, 2, 3, 7, 8, and 9, the receiving system would be able to determine that data was missing. If the data was being transmitted in a mode allowing for retransmission, the receiving system could then send a request back to the transmitting system, requesting that the missing information be re-sent. Additionally, if packets were received out of order, the sequence number allowed the receiving system to reassemble them in the correct order and interpret the final set of data correctly. This could happen when some packets were routed through a longer path through a network, and others were routed through a shorter path, causing them to arrive in a different order than they were transmitted.

47. For example, in wireline internet systems (including DSL), the header for packets sent using the TCP protocol always contains a sequence number field:



TCP Header Format

Note that one tick mark represents one bit position.

Figure 3.

RFC 793, “Transmission Control Protocol,” Information Sciences Institute, Sept. 1981 (“RFC 793”) (Ex. 1007), Fig. 3. Each packet receives a sequential sequence number. *Id.*, 24. The sequential numbering of TCP packets allows the receiving system to acknowledge receipt of each packet, and allows for duplicate detection when data is retransmitted. *Id.*

## 2. Noise in Data Transmission

48. All data transmission systems have some level of error that can affect the quality of transmissions. Noise is one impairment degrading the performance of data transmission systems. Noise is generally considered to be a random, unpredictable process but complex, deterministic processes, such as cross-talk from a multitude of independent sources are often modeled as noise for lack of a

better analytical model.

49. For example, DSL systems are subject to the ever-present so-called thermal noise in the transmission line; impulse noise generated by lightning strikes, electrical power disturbances, or switching transients; cross-talk from other voice or DSL users' communications; interference due to ingress from external radio signals using the same spectrum as the DSL system, such as AM broadcast, amateur radio, and shortwave broadcast; and signal loss due to transmission line attenuation or signal reflections in the local loop plant. This is not unique to DSL. Earlier voiceband analog modems I worked on had many of the same issues while the wireless systems I worked on had all of these, some exacerbated by the rapid variation in the transmission channel due to varying transmission distance and movement of the stations.

### **3. Speed and Accuracy in Data Transmission**

50. All communications systems may be called upon to transmit information of varying levels of importance, tolerant of varying levels of delay or error. For instance, consider the Internet, originally conceived of as the Advanced Research Projects Agency (ARPA) ARPANET as a highly survivable network, assuring messages could be delivered to the destination if any transmission route existed, anywhere in the network. While the intent was to be able to deliver

information delivery in the face of widespread damage to the network, this reliability comes at the price of delay, since packets must be stored until it is verified that they are delivered, potentially allowing retransmission of any lost packets.

51. In contrast to the design philosophy of the Internet, consider modern interactive services, such as Voice over IP (VoIP) or video services such as Zoom. In these interactive services, delay is to be minimized and delay variation is intolerable. Segments of the transmission must all be delivered with the same delay or the resulting audio or video will become choppy. Interestingly, both voice and video can tolerate brief interruptions, as long as everything arrives at the proper time. In my experience with secure voice systems and wireless voice systems, I have seen that drop-outs on the order of 50 milliseconds, about the length of a single syllable, are not even noticed by the listener, as long as the number of drop-outs is not too large and as long as they are not periodic. For this reason, streaming and interactive services can tolerate some packet loss, as long as (a) they don't occur too often and (b) there is no delay variation.

52. Recognizing that many networks carry a variety of information types, such as those that do not involve real-time interaction (email, text messages, web pages, network control and the like) as well as those that do involve real-time

interaction (voice, streaming video, and the like), networks must provide a means to transmit each type of traffic with the treatment it requires. While all packets can be protected against an undetected error, e.g., using a Cyclic Redundancy Check (CRC), or protected from undetected packet loss, e.g., using a packet sequence number, in the event that a packet is lost (e.g., a missing sequence number) or received in error (e.g., an incorrect CRC checksum), the network must consider what to do. If reliability of delivery is more important than delay, packets can be stored at the source until delivery is confirmed in case retransmission is needed. If delay is more important, lost or errored packets are simply dropped. The intermediate network nodes may not track the original application sending the packets, so typically a packet priority marker is used to allow network nodes to know how packet errors are to be treated.

53. As of April 12, 2006, it was well known in the field of data transmission that there was often a trade-off between speed of transmission and quality of transmission. Various techniques were known for reducing error rate in transmissions, including forward error correction and retransmission. It has long been known that information coding techniques that detect, rather than correct, errors can deal with a greater number of errors. While error correcting codes add redundancy, slowing transmission, they are not capable of correcting all the errors



that might occur. For this reason, relying on codes that can detect errors only is often the optimum choice. However, these techniques only allow errored messages to be detected, offering two options: simply reject the incorrect message or request a retransmission. Unfortunately, if a retransmission is required, the original copy must be stored at the transmitter and repeated at a later time, adding transmission delay.

54. Quality of service (“QoS”) was the commonly used term to describe the need of a communication system to be able to provide service delay and error rate assurances. QoS addresses measures such as packet loss rate, bit rate, throughput, transmission delay, and transmission delay variation (jitter).

#### **4. Retransmission**

55. As mentioned above, one well-known method for reducing error rate in transmissions was the retransmission of data. ARQ (automatic repeat query or automatic repeat request) protocols are a historical class of protocols that allow a receiver to request the transmitter to repeat a previous transmission. In the simplest case, an ARQ protocol is equivalent to the human interaction where a listener says “I didn’t understand, could you please repeat your last comment?” According the IEEE Iexplore conference and journal database, there are about 1500 articles published between 1960 and 2005 describing ARQ systems. Besides TCP/IP, ARQ

protocols have been used in X.25 networks, wireless relay networks, WiFi (802.11), 3G and more recent cellular networks, and countless other systems.

## **5. QoS in Data Transmission Protocols**

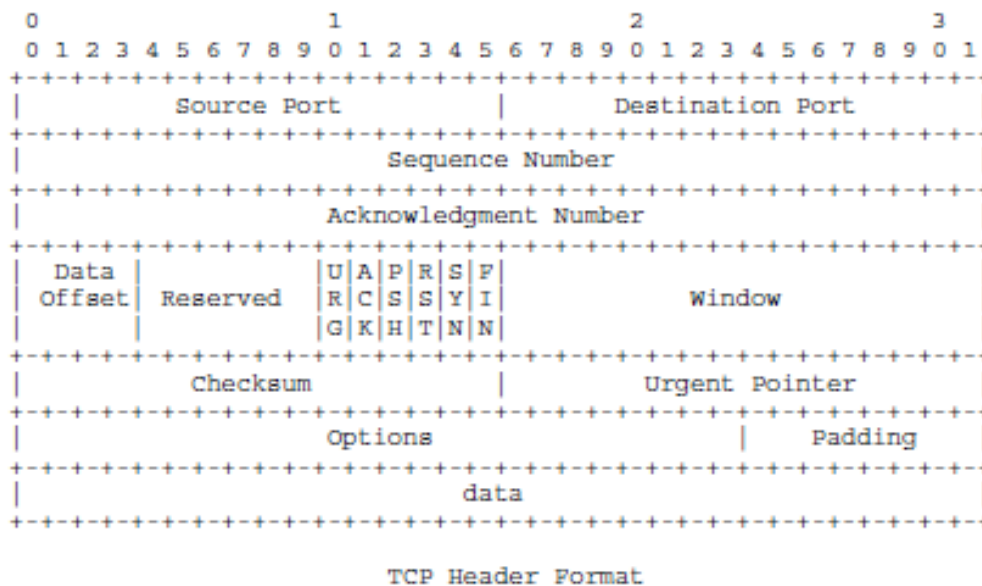
56. Different types of data have different levels of sensitivity to delays that occur during transmission as discussed above. Information streams that do not require real-time interaction, such as email, broadcast messages, or web page downloads can tolerate delays and even delay that varies from one segment to the next. On the other hand, information streams that require real-time interaction, such as a digitized voice call or video conference require low delay and especially near constant delay. Standard data transmission systems therefore incorporated protocols for transmitting data in multiple modes, some of which were designed to prioritize low delay and others of which were designed to prioritize low error rate.

57. Standard Internet protocols used in all wired internet systems (including DSL) include modes of transmission with different QoS.

58. One common transmission protocol is Transport Control Protocol (“TCP”), a mode of transmission that improves error rate, including through retransmission of lost packets when needed. TCP is useful for maintaining transmission quality of non-real-time data, but the retransmission process creates delays which reduce its utility for real-time data. *See, e.g.,* U.S. Patent Application

Publication No. US 2004/0252700 (“Anandakumar”) (Ex. 1010), ¶¶0013]; U.S. Patent Application Publication No. US 2003/0067903 (“Jorgensen”) (Ex. 1011), ¶¶0385]; Reynders, 123.

59. All packets sent using TCP receive a header of the following format, including a sequence number:



Note that one tick mark represents one bit position.

Figure 3.

RFC 793, Fig. 3; *see also* Reynders, 129. The sequence number is incremented for each TCP packet that is transmitted, allowing each byte of data sent over the TCP connection to have a unique sequence number. Reynders, 124.

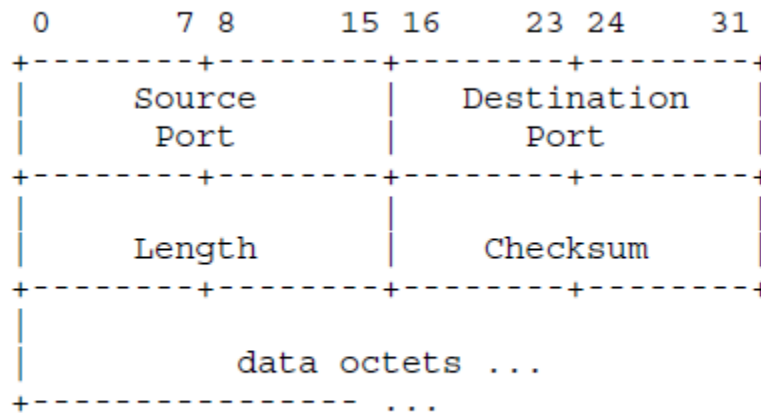
60. When each TCP packet is transmitted, the transmitting system stores the packet temporarily in a retransmission queue, also known as a retransmission buffer. RFC 793, 7-8. When a TCP packet is successfully received, the receiving

system transmits a positive acknowledgement (“ACK”) of receiving the packet with that sequence number. *Id.*; *see also* Reynders, 125-126; International Patent Application Publication No. WO 01/80558 (“Bastone”) (Ex. 1012), 3:20-5:20. If the transmitting system does not receive an ACK within a timeout interval for a particular TCP packet, it retransmits that packet, to ensure that it is eventually received. RFC 793, 10; Reynders, 125-126; Bastone, 5:11-13. This process allows TCP to “recover[] from internet communication system errors,” RFC 793, 4, but creates delay, including because of the time required for the receiving system to send a reply. Bastone, 5:10-20.

61. An alternative to TCP is the User Datagram Protocol (“UDP”), set forth in RFC 768. Unlike TCP, UDP does not require acknowledgement of receipt of packets, and does not involve retransmission of packets. RFC 768, “User Datagram Protocol,” Information Sciences Institute, Aug. 1980 (“RFC 768”) (Ex. 1008), 1; Anandakumar, ¶[0212]; Reynders, 131 (“Sending a UDP datagram [e.g., a UDP/IP packet] involves very little overhead in that there [is]... no retransmission of packets.”). However, while these features of UDP make it less reliable, they avoid the delay caused by TCP’s acknowledgement and retransmission requirements, making UDP more suitable for real-time delivery of data such as video or voice. Jorgensen, ¶[0363]; Bastone, 6:4-14; International

Patent Application Publication No. WO 00/45581 (“Oliver”) (Ex. 1013), 1:33-34;  
RFC 768, 1; Reynders, 131.

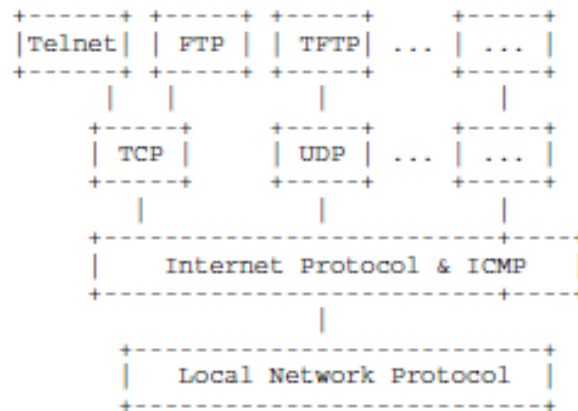
62. UDP packets require the following header information:



User Datagram Header Format

RFC 768, 1. Unlike TCP packets, UDP packets do not contain sequence numbers.  
*Id.*; Reynders, 131.

63. As discussed above, TCP or UDP is only one protocol layer for packet transmission. Of particular relevance to the '055 patent, a packet sent by TCP or UDP on the Internet also requires an internet protocol (“IP”) header:

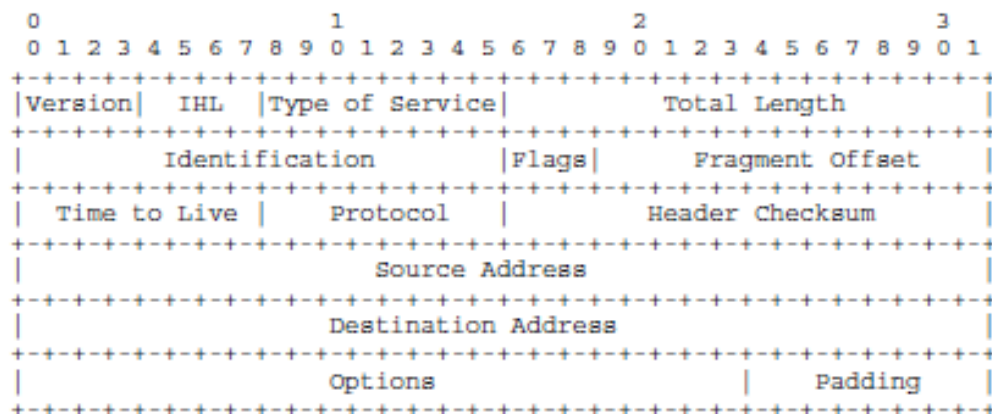


Protocol Relationships

Figure 1.

RFC 791, Fig. 1.

64. RFC 791 governs the format of IP packets. IP packets have the following header information:



Example Internet Datagram Header

Figure 4.

RFC 791, Fig. 4.

65. Of particular relevance to the '055 patent, an IP header contains the 8-bit “Protocol” field, which indicates the “next-level protocol” to be used with the

IP packet—e.g., whether the next protocol layer is TCP, or UDP, or some alternate protocol. *Id.*, 14; RFC 762, “Assigned Numbers,” Information Sciences Institute, Jan. 1980 (“RFC 762”) (Ex. 1014), 4. The numbering system for the Protocol field is defined in RFC 790, which states that a decimal value of 6 indicates a TCP packet, while a decimal value of 17 indicates a UDP packet. RFC 790, “Assigned Numbers,” Information Sciences Institute, Sept. 1981 (“RFC 790”) (Ex. 1009), 6.

## **6. DSL and ADSL**

66. Digital subscriber line (“DSL”) is a family of technologies used to transmit digital data over telephone lines for Internet access. Asymmetric digital subscriber line (“ADSL”) is the most commonly installed DSL technology.

67. As of the priority date of the ’055 patent, several methods were known for connecting users to the Internet, including dial-up modems, ISDN connections, and leased lines. Reynders, 199. However, DSL was rapidly gaining in popularity, because DSL technologies were able to achieve faster data rates by using additional available bandwidth and “taking advantage of breakthroughs in error correction coding, modulation, equalization, echo cancellation, and digital signal processing.” *See, e.g.*, Halapoto, I. A., Chowdhry, B. S., Abro, F. R., “Implementation of DSL in Pakistan-Growth, Potential and Bandwidth Impact – A Technical Report,” Mehran University Research Journal of Engineering and

Technology, Volume 24, No. 3 (July 2005) (“Halapoto”) (Ex. 1015), 222; *see also* Sutherland, B., “The Alcatel Experience of DSL Deployment, The Institution of Electrical Engineers, 2000 (“Sutherland”) (Ex. 1016), 4/1. As of the priority date of the ’055 patent, the number of global DSL subscribers was growing rapidly, and DSL prices were reducing. Halapoto, 225.

68. As of the priority date of the ’055 patent, the International Telecommunication Union had released several standards governing the functionality of DSL transceivers. *See generally, e.g.*, ITU-T Recommendation G.992.1, “Asymmetric digital subscriber line (ADSL) transceivers” (June 1999) (“G.992.1”) (Ex. 1017); ITU-T Recommendation G.993.1, “Very high speed digital subscriber line transceivers” (June 2004) (“G.993.1”) (Ex. 1018); ITU-T Recommendation G.992.3, “Asymmetric digital subscriber line transceivers 2 (ADSL2)” (July 2002) (“G.992.3”) (Ex. 1019).

**a. Reed-Solomon Codes**

69. Error correction techniques enable a receiver to detect the presence of errors in a decoded signal and to potentially correct at least some of those errors. To apply an error correction code, the transmitter adds redundant information to a message to be transmitted. The receiver then uses the redundant information to detect a limited number of errors that may occur anywhere in the message, and



often to correct those errors without retransmission. When the communication system uses an error correction code, the receiver can correct at least some errors in the received data, which reduces and could eliminate entirely data lost to errors as well as any need for the receiver to request retransmission.

70. One well-known example of an error correction code is the Reed-Solomon code, first described in 1960 and since used in a wide variety of systems including CDs, DVDs, computer disk drives, satellite and wireless communications, and recently specified for and used in ADSL since the mid-1990s. Reed-Solomon codes encode blocks of data to be transmitted in such a way that errors in certain elements of the block can be corrected if enough other elements of the block are error-free. As long as enough elements of a block are error-free, the redundancy elements allow the receiver to correct all of the errors in the rest of the block.

71. The  $N$  elements in each Reed-Solomon codeword include  $K$  data elements (i.e., the data to be transmitted in the codeword, sometimes referred to as payload) and  $R$  redundancy elements that result from the Reed-Solomon code calculation. Thus,

$$N = K + R.$$

72. The mathematics of Reed-Solomon codes are complicated, but the

essential property is that the maximum number of data elements with any number of errors that can be corrected is equal to half of the number of redundancy elements. In other words, a Reed-Solomon code can correct as many as  $R/2$  errored data elements, regardless of how many individual errors are within those data elements.<sup>3</sup>

73. As a simple example, if the elements in a Reed-Solomon codeword are bytes, and  $R = 16$ , up to 8 erroneous bytes can be corrected, regardless of how many bits of each errored byte are in error. Whether a byte contains one bit error or eight, the Reed-Solomon code will correct all bit errors in up to 8 bytes. Thus, Reed-Solomon codes are particularly helpful for use in environments that suffer from impulse noise because any erroneous element counts as a single error regardless of how many bits of that element are in error.

74. The use of Reed-Solomon codewords has been mandatory for years in DSL standards documents. *See, e.g.*, ATIS ADSL Standard T1.413 Issue 1 (1995) (“T1.413 Issue 1”) (Ex. 1020), 35; G.992.1, §7.6.1 (“R . . . redundant check bytes . . . shall be appended to K . . . message bytes . . . to form a Reed-Solomon codeword of size  $N = K + R$  bytes.”); G.992.3, §7.2 (“[T]he ATU transmit PMS-TC function also provides procedures for: . . . insertion of redundancy for Reed-

<sup>3</sup> This discussion assumes that erasures are not used.

Solomon-based forward error correction”); G.993.1, §8.3. (recommending use of “a standard byte-oriented Reed-Solomon code . . . to provide protection against random and burst errors”). This is implemented by “append[ing]” Reed-Solomon codewords to the transmitted packet, in the information added at the DSL layer. *See, e.g., G.992.3, 37.*

**b. PTM-TC Codewords**

75. The acronym “PTM-TC” stands for “Packet Transfer Mode – Transmission Convergence,” a DSL-specific term, but the underlying concept is not unique to DSL. “Packet transfer” refers to the fact that data in a DSL system is not transmitted as a continuous data stream, but is separated into discrete packets. “Transmission convergence” refers to incoming data: if incoming data is already in packet form, it can be transmitted as-is, but if it is a continuous stream, it will be rearranged and broken into packets.

76. In DSL, information that is to be conveyed across the network may originate in the form of continuous data streams or information that has already been formed into packets. If the information originated as a continuous data stream, it must be repackaged into discrete packets for transmission. On the other hand, if the information was already in packet form, for instance, IP (Internet Protocol) packets, it could be simply be trimmed or padded to fit into the desired

DSL packet format, applying the appropriate QoS, error control and sequencing headers. Information that is transmitted using forward error correction is grouped into a series of bits of information and coding redundancy, the total collection referred to as a “codeword.”

77. Various DSL standards prior to the priority date required the use of PTM-TC and therefore PTM-TC codewords. *See, e.g.*, G.993.1, 143 (“In the transmit direction... [t]he corresponding TPS-TC (PTM-TC) receives the packet from the  $\gamma$  interface, encapsulates it into a special frame (PTM-TC frame) and maps into the PMS-TC frame (transmission frame) for transmission over the VDSL link”); G.992.3, 294 (identifying requirement of “Packet transmission convergence function (PTM-TC)”).

## **B. Overview of the '055 Patent**

78. The '055 patent is entitled “PACKET RETRANSMISSION AND MEMORY SHARING.” '055 patent, ¶54.

79. The '055 patent discloses a communications system utilizing retransmission. *Id.*, 1:28-33. The '055 patent discloses that the system includes a transceiver 200 transmitting information to a receiving transceiver 300, shown below in Figure 1 from the patent:

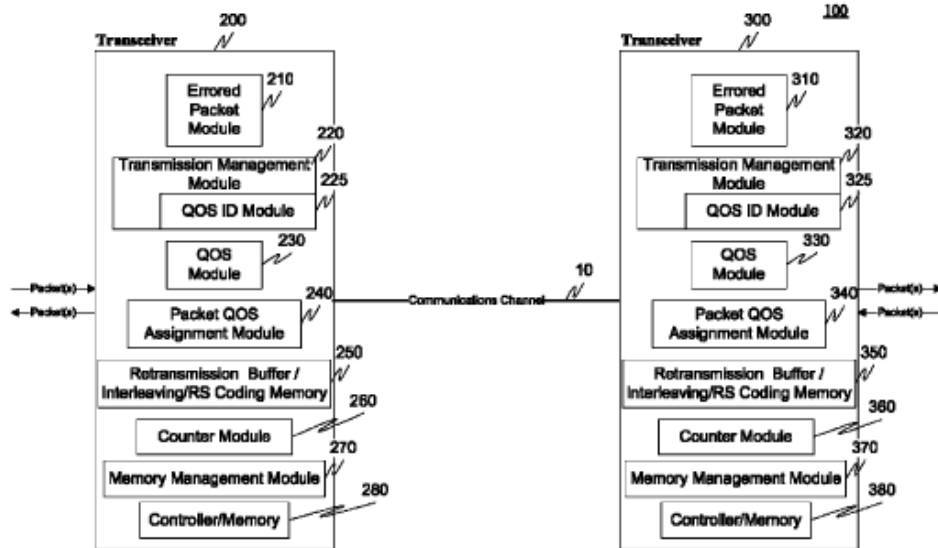


Fig. 1

*Id.*, Fig. 1.

80. The '055 patent discloses that different types of information that the system transports have a different Quality of Service (QOS) metrics. *Id.*, 1:49-55. The '055 patent explains that two QOS metrics are latency and Packet Error Rate (PER). *Id.*, 1:56-57.

81. The '055 patent explains that video information typically requires transmission at a low error rate but can tolerate a degree of latency; whereas, voice information typically requires a lower latency but can tolerate a relatively higher error rate:

As an example, in the case where the two QOS metrics are latency and PER, packets containing, for example, video information (such as IPTV) may have the requirement for a very low packet error rate but can often

tolerate higher delay. In contrast, voice or data (e.g., gaming) traffic may have very low latency requirements but can tolerate a higher packet error rate.

*Id.*, 1:64-2:3.

82. The '055 patent describes packets of information that require a low error rate as "low-PER" packets and packets that require a low latency as "low-latency" packets. *Id.*, 2:3-6. The '055 patent discloses that packets can have header fields and the type of packet can be indicated by the information in the header:

Certain bit fields in the header of data portions of each packet could contain certain values that specify the QOS requirements a packet. For example, the packet header could contain bit fields that indicate if the packet has a "low-PER" QOS requirement or a "low-latency" QOS requirement. These fields could be read by the transmitting modem and/or receiving modem to determine the QOS level of each packet.

*Id.*, 11:25-31.

83. The '055 patent explains that because retransmission reduces packet error but introduces latency, low-PER packets can be transmitted using a retransmission protocol; while, low-latency packets can be transmitted without retransmission:

For example, a specific QOS identifier could be assigned to the low-latency packets while a different QOS identifier could be assigned to the low-PER packets. The low-latency packets could be forwarded directly to another transceiver, or a higher layer, while the low-PER

packets can be stored in a retransmission buffer, e.g., memory, that can be used to reduce packet error.

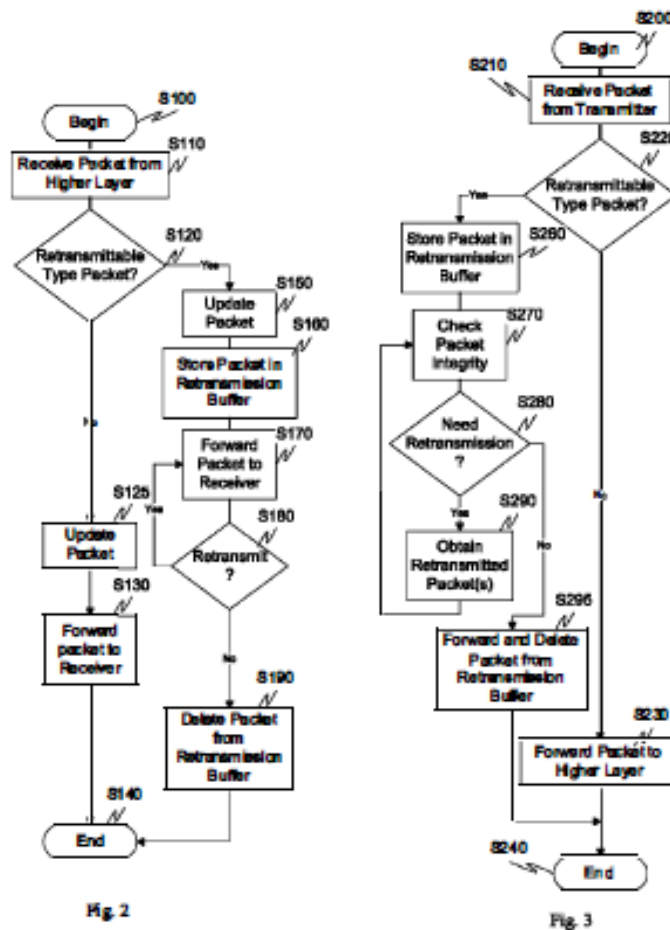
*Id.*, 2:8-12.

84. The '055 patent discloses that in order to keep track of which packets need to be retransmitted, the system adds a packet Sequence ID (SID) to the low-PER packets. *Id.*, 12:8-15. The packet SID, which can be appended to the header field, allows the receiving transceiver to identify the packet that needs to be retransmitted:

For successful retransmission, the receiving modem should be able to inform the transmitting modem which packet, or packets, need to be retransmitted. One exemplary way of performing this is by transmitting packets with an appended bit field that contains a counter indicating the place of each packet in a stream of packets. This counter value is also known as a Sequence ID (SID). For example, a bit field containing a 16-bit counter could be appended to each packet and the counter module 260 would be incremented by one after each packet was transmitted. In cooperation with the packet assignment module 240, a packet counter field could be appended to the packet in a number of places, for example, at the beginning or end of the packet, or at the beginning or end of the packet header.

*Id.*, 12:40-53.

85. The '055 patent describes how the system operates by reference to Figures 2 and 3:



*Id.*, Figs. 2, 3.

86. As shown in Figure 2, in step S120, the system determines whether a packet is a low-PER packet or a low-latency packet. *Id.*, 21:11-12. If the packet is a low-latency packet, the system transmits the packet at step S130 without appending a packet SID and without retransmission. *Id.*, 21:12-18. Conversely, if the packet is a low-PER packet, the system appends a packet SID to the packet at step S150 and stores the packet in a retransmission buffer at step S160 before transmitting the packet to a receiving transceiver at step S170. *Id.*, 21:19-27.



87. As shown in Figure 3, the receiving transceiver also determines whether the packet is a low-PER or low-latency packet at S220 and performs similar operations on the packet depending on that determination as described with respect to the transmitting transceiver. *Id.*, 21:35-61.

### **C. Prosecution History**

88. The '055 patent issued from U.S. Application No. 14/159,125 (“the '125 application”), filed on January 20, 2014. *Id.*, cover page. The '125 application is a continuation of U.S. Application No. 13/766,059, filed February 13, 2013, now U.S. Patent No. 8,645,784, which is a continuation of U.S. Application No. 12/783,758, filed May 20, 2010, now U.S. Patent. No. 8,407,546, which is a continuation of U.S. Application No. 12/295,828, filed October 2, 2008, now U.S. Patent No. 8,335,956, which is the national stage application under 35 U.S.C. § 371 of PCT Application No. PCT/US2007/066522 having an international filing date of April 12, 2007, which claims the benefit of U.S. provisional Application Nos. 60/792,236, filed on April 12, 2006, and 60/849,650, filed on October 5, 2006. '055 patent, 1:6-22.

89. As filed, the '125 application had 105 claims. Prosecution History of U.S. Patent Application No. 14/159,125 (Ex. 1002), 53-69. In a preliminary amendment filed on January 20, 2014, the same day the application was filed, the

applicant canceled claims 9-105, leaving only claims 1-8 pending. *Id.*, 3-4. Claim 1 recited:

A method of packet retransmission comprising:  
transmitting or receiving a plurality of packets;  
identifying at least one packet of the plurality of packets  
as a packet that should not be retransmitted.

*Id.*, 3.

90. In addition to canceling claims 9-105, in the written description, the applicant added priority claims to U.S. Application No. 13/766,059 (U.S. Patent No. 8,645,784), U.S. Application No. 12/783,758 (U.S. Patent No. 8,407,546), U.S. Application No. 12/295,828 (U.S. Patent No. 8,335,956), and PCT Application No. PCT/US2007/066522. *Id.*, 80. The applicant also corrected certain typographic errors and changed certain references to xDSL systems from “G.993.2” to “G.992.3” and from “G.993.5” to “G.992.5.” *Id.*, 104.

91. On March 10, 2014, the applicant filed another preliminary amendment, cancelling claims 1-105 and adding new claims 106-125. *Id.*, 315-317.

New claim 106 recited:

A method of packet retransmission, in a transceiver,  
comprising:  
transmitting a first type of packet; and  
transmitting a second type of packet,

wherein the first type of packet is stored in a retransmission buffer after transmission and the second type of packet is not stored in a retransmission buffer after transmission,

wherein the first and second types of packet comprise a header field that indicates whether a transmitted packet is a first type of packet or a second type of packet, and

wherein the header field of the first type of packet comprises a sequency identifier (SID) that is incremented after the first type of packet is transmitted and the header field of the second type of packet does not comprise the SID of the first type of packet.

*Id.*, 315. Applicant made no amendments to the written description.

92. On February 6, 2015, the Examiner sent a non-final Office Action rejecting claims 112, 113, 122, and 123 under 35 U.S.C. § 112 and claims 106-125 under 35 U.S.C. § 103. *Id.*, 346-357.

93. As to the rejections under 35 U.S.C. § 112, the examiner stated that the abbreviations “PTM-TC” in claims 112 and 122 and “ATM” in claims 113 and 123 were not defined. *Id.*, 349.

94. As to the rejections under 35 U.S.C. § 103, the examiner found all pending claims unpatentable over U.S. Application No. 2007/0206621 to Plamondon (“Plamondon”) in view of U.S. Application No. 2002/0126675 to Yoshimura (“Yoshimura”). *Id.*, 350-356. The Examiner found that Plamondon teaches a method of packet retransmission in a transceiver, including every

limitation of the pending claims except the requirement that the second type of packet does not comprise the sequence identifier (“SID”) of the first type of packet. *Id.*, 350-51, 353-54. The Examiner found that Yoshimura teaches that the header field of the second type of packet does not comprise the SID of the first type of packet and found that it would have been obvious to a person having ordinary skill in the art to combine the teachings of Plamondon and Yoshimura. *Id.*, 351, 354.

95. On April 8, 2015, the applicant’s representative, Jason Vick, and the Examiner held an applicant-initiated interview. *Id.*, 391-393. Mr. Vick argued that Plamondon does not teach two different types of packets or the limitation “wherein the first and second types of packet comprise a header field that indicates whether a transmitted packet is a first type of packet or a second type of packet.” *Id.*, 392. The Examiner disagreed with the first argument, but as to the second argument, agreed to review the reference and update the search once applicant filed a response to the Office Action. *Id.*

96. On April 23, 2015, the applicant responded to the Office Action by amending certain claims. *Id.*, 394-98. Claim 106 was amended to specify that the “transmitting” steps are both performed “by the transceiver.” *Id.*, 395. Claims 112, 113, 115, 122, 123, and 125 were amended to define the acronyms “PTM-TC,”

“ATM,” and “PER.” *Id.*, 396-97. The applicant stated that the amendments addressed the rejection under 35 U.S.C. § 112 and, referencing the April 8, 2015 interview, stated that “[t]he Examiners agree the claims were distinguishable from the references” and requested withdrawal of the rejections. *Id.*, 398.

97. On June, 16, 2015, the Examiner mailed an Office Action finally rejecting claims 106-125. *Id.*, 412-25. The Examiner again found all pending claims unpatentable under 35 U.S.C. § 103 over Plamondon in view of Yashimura. *Id.*, 417-23. The Examiner noted in response to applicant’s argument that Plamondon does not teach the limitation “wherein the first and second types of packet comprise a header field that indicates whether a transmitted packet is a first type of packet or a second type of packet,” that Yashimura teaches this limitation. *Id.*, 414-16.

98. On December 2, 2015, the applicant’s representative, Jason Vick, and the Examiner held an applicant-initiated interview. *Id.*, 487-89. Mr. Vick argued that the cited portion of Yashimura fails to teach the limitation “the header field of the second type of packet does not comprise the SID of the first type of packet.” *Id.*, 488. The Examiner agreed to review the cited references and update the search if an amendment or arguments were filed. *Id.*

99. On December 2, 2015, the same day as the interview, the applicant

filed a request for continued examination (RCE) and an amendment after final. *Id.*, 472-84. The applicant submitted no amendments, and argued only that the rejections should be withdrawn on the basis of arguments made during the interview. *Id.*, 484.

100. On December 31, 2015, the Examiner sent a non-final Office Action rejecting claims 106-125. *Id.*, 510-21. The Examiner found all pending claims unpatentable under 35 U.S.C. §103 over Plamondon in view of U.S. Patent No. 6,266,337 to Marco (“Marco”). *Id.*, 513-20. The Examiner again noted that Plamondon does not teach that the second type of packet does not comprise the SID of the first type of packet, but found that Marco does teach this limitation and that it would have been obvious to a person having ordinary skill in the art to modify Plamaondon with the teachings of Marco. *Id.*, 513-14, 516-18.

101. On April 12, 2016, the applicant’s representative, Jason Vick, and the Examiner held an applicant-initiated interview. *Id.*, 566-68. Mr. Vick argued that the cited references fail to teach the limitation “wherein the first type of packet is stored in a retransmission buffer after transmission and the second type of packet is not stored in a retransmission buffer after transmission, wherein the header field of the first type of packet comprises a sequence identifier (SID) that is incremented after the first type of packet is transmitted and the header field of the second type

of packet does not comprise the SID of the first type of packet.” *Id.*, 569. The examiner agree to review the references and update the search should applicant file an amendment or argument. *Id.* No agreement was reached. *Id.*

102. On April 26, 2016, the applicant submitted a response to the Office Action. *Id.*, 569-75. The applicant argued that neither Plamondon nor Marco teach that the header field of the first type of packet comprises a SID that is incremented after the first type of packet is transmitted. *Id.*, 573-74.

103. On August 1, 2016, the Examiner mailed a notice of allowability, indicating that claims 106-125 are allowed. *Id.*, 603-07. On October 6, 2016, the Examiner mailed a corrected notice of allowability that included a statement of reasons for allowance. *Id.*, 698-701. The Examiner noted that the documents listed in applicant’s Information Disclosure Form, filed September 16, 2016, had been reviewed and none of the references anticipated or rendered obvious the allowed claims. *Id.*, 700. Claims 106-125 issued as claims 1-20, respectively.

#### **D. The Challenged Claims**

104. This Declaration addresses claims 1, 4, 5, 7, 9, 10, 11, 14, 15, 17, 19, and 20 of the ’055 patent. Claims 1 and 11 are independent claims.

105. Independent claim 1 recites:

1[pre]	A method of packet retransmission, in a transceiver, comprising:
--------	--

1[a]	transmitting, by the transceiver, a first type of packet; and
1[b]	transmitting, by the transceiver, a second type of packet,
1[c]	wherein the first type of packet is stored in a retransmission buffer after transmission and the second type of packet is not stored in a retransmission buffer after transmission,
1[d]	wherein the first and second types of packet comprise a header field that indicates whether a transmitted packet is a first type of packet or a second type of packet, and
1[e]	wherein the header field of the first type of packet comprises a sequence identifier (SID) that is incremented after the first type of packet is transmitted and the header field of the second type of packet does not comprise the SID of the first type of packet.

106. Independent claim 11 recites:

11[pre]	A transceiver operable
11[a]	to transmit a first type of packet and
11[b]	to transmit a second type of packet,
11[c]	wherein the first type of packet is stored in a retransmission buffer after transmission and the second type of packet is not stored in a retransmission buffer after transmission, and



11[c]	wherein the first and second types of packet comprise a header field that indicates whether a transmitted packet is a first type of packet or a second type of packet, and
11[d]	wherein the header field of the first type of packet comprises a sequence identifier (SID) that is incremented after the first type of packet is transmitted and the header field of the second type of packet does not comprise the SID of the first type of packet.

107. I have added indices of the form 1[pre], 1[a], 1[b], 1[c], etc. to the claim limitations for ease of reference and to match the indices used in the Petition.

108. I note that all of the 055 claims, while referencing a transceiver, only describe functions of the transmitter, not the receiver.

109. Claims 4, 5, 7, 10, and 11 depend from claim 1 and claims 14, 15, 17, 19, and 20 depend from claim 11.

110. Claims 4 and 14 require that the method is performed (claim 4), or the transceiver is located (claim 14), “in a customer premises modem that is operable to transport video.”

111. Claims 5 and 15 require that the transceiver includes at least one digital signal processor.

112. Claims 7 and 17 require that the first type of packet comprises one or

more PTM-TC (Packet Transfer Mode-Transmission Convergence) codewords.

113. Claims 9 and 19 require that the first type of packet comprises one or more Reed Solomon codewords.

114. Claims 10 and 20 require that “the first type of packet is a low-PER (Packet Error Rate) packet and the second type of packet is a low-latency packet.”

## **V. CLAIM CONSTRUCTION**

115. I understand that the terms “transceiver” and “packet” were previously construed by the Court in the case styled *TQ Delta, LLC v. Adtran, Inc.*, 1:14-cv-000954-RGA (D. Del.) involving U.S. Patent No. 8,468,411, which is related to the ’055 patent and shares a common specification. The Court construed “transceiver” as “communications device capable of transmitting and receiving data wherein the transmitter portion and receiver portion share at least some common circuitry” and “packet” as “a grouping of bytes.” Claim Construction Order, *TQ Delta, LLC v. Adtran, Inc.*, 1:14-cv-000954-RGA (D. Del.), Dkt. No. 396 (D. Del. May 15, 2018) (“Claim Construction Order”) (Ex. 1021), 2. I have applied the Court’s claim construction for these terms in forming my opinions below.

116. For the purposes of this IPR proceeding, I apply the ordinary and customary meaning of the other words in the claims of the ’055 patent as they

would have been understood by a person having ordinary skill in the art in view of the specification and the prosecution history pertaining to the patent in forming my opinions below.

## **VI. APPLICATION OF THE PRIOR ART TO THE CHALLENGED CLAIMS**

117. In my opinion, the claims of the '055 patent are unpatentable based on the following prior art identified in the following grounds:

<b><i>Ground</i></b>	<b><i>Statute</i></b>	<b><i>References</i></b>	<b><i>Claims</i></b>
1	§103(a)	U.S. Patent Application Publication No. 2005/0036497 ("Kawakami")	1, 5, 10, 11, 15, 20
2	§103(a)	Reynders	1, 4, 5, 7, 9, 10, 11, 14, 15, 17, 19, 20
3	§103(a)	RFC 791, RFC 793, and RFC 768	1, 4, 5, 7, 9, 10, 11, 14, 15, 17, 19, 20

118. I am informed by counsel that each reference listed above qualifies as prior art to the challenged claims because each reference was published before the earliest claimed priority date.

### **A. Brief Summary of Prior Art**

#### **1. U.S. Patent Application Publication No. 2005/0036497 to Kawakami ("Kawakami") (Ex. 1004)**

119. U.S. Patent Application Publication No. 2005/0036497 (Ex. 1004) by

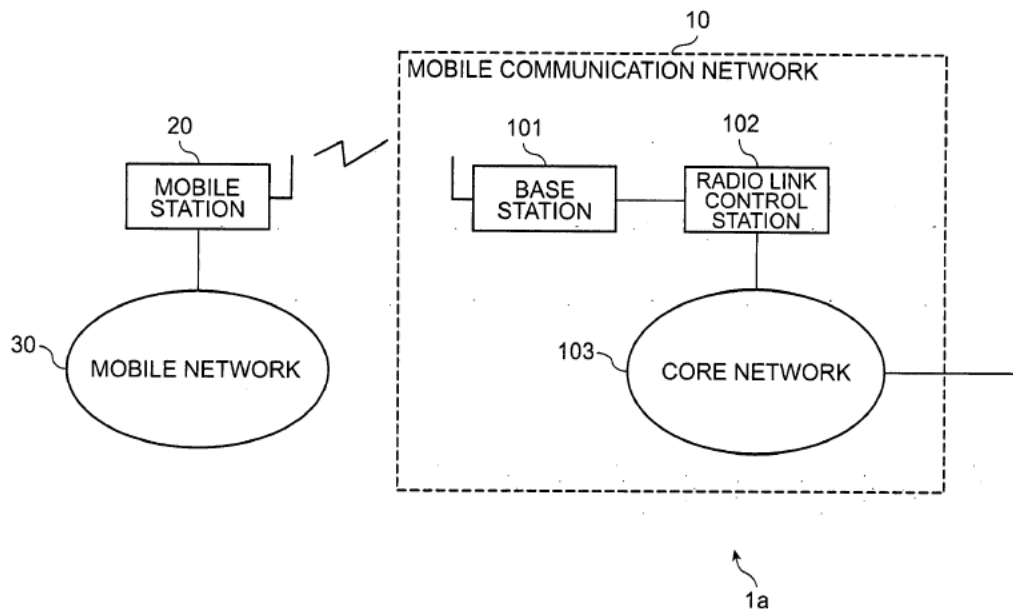
Kawakami is entitled “FRAME TRANSMISSION/RECEPTION SYSTEM, FRAME TRANSMITTING APPARATUS, FRAME RECEIVING APPARATUS, AND FRAME TRANSMISSION/RECEPTION METHOD.” Kawakami, §(54).

Kawakami was published on February 17, 2005. *Id.*, §(43). I am informed that Kawakami qualifies as prior art under 35 U.S.C. §102(b) because it was published more than one year before the priority date of the '055 patent.

120. Kawakami was listed on an Information Disclosure Statement that was considered by the Examiner, but the Examiner did not apply Kawakami in a prior art rejection. *See* '055 prosecution history, 443.

121. Kawakami discloses a mobile communications system including a mobile station and radio link control station, as shown in Figure 1, reproduced below:

**Fig.1**



As a premise for the description of the present embodiment a network 1a (frame transmission/reception system) will be described using FIG. 1. This network 1a is comprised of a mobile communication network 10, a mobile station 20, and a mobile network 30. The mobile communication network 10 includes a base station 101, a radio link control station 102, and a core network 103. The mobile station 20 has a radio interface to access the mobile communication network 10 and is linked to the mobile network 30 consisting of at least one communication terminal. The base station 101 has a radio interface to the mobile station 20, and an interface to the radio link control station 102. The radio link control station 102 is able to communicate with the exterior of the mobile communication network 10 through the core network 103. In the network 1a of FIG. 1, the base station 101 and the radio link control station 102 are described as separate nodes, but they can also be configured as a single node. The mobile station 20 transfers data flows from many communication terminals

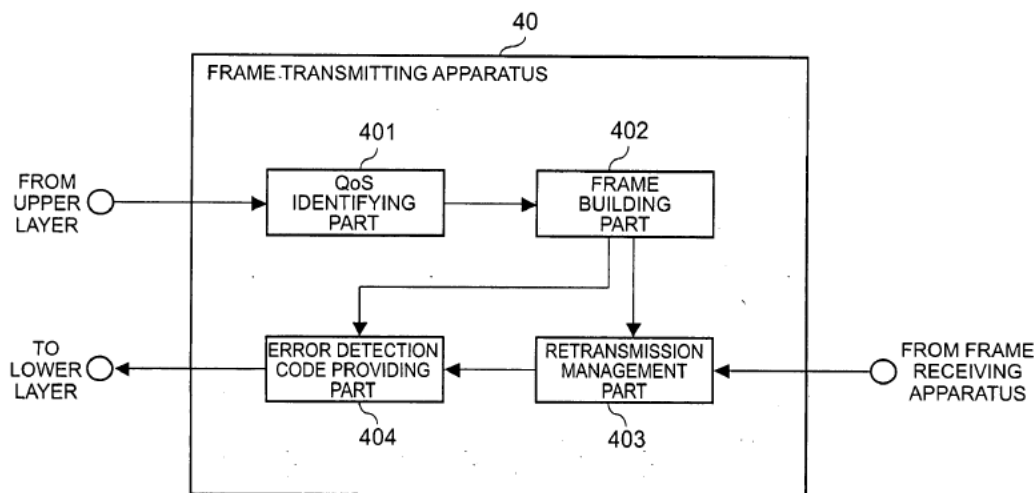
of the mobile network 30 through one radio interface to the mobile communication network 10.

Kawakami, Fig. 1, ¶[0032].

122. Kawakami discloses that the mobile station and control station include a frame transmitting apparatus and a frame receiving apparatus. *Id.*, ¶[0034]. I note that while Kawakami refers to “frames” and “packets” separately, the “frames” in Kawakami are packets under the construction for “packet” that I have applied in this declaration (i.e. “a grouping of bytes”).

123. The frame transmitting apparatus includes a number of components, including a frame building part as shown in figure 2, reproduced below:

**Fig.2**



*Id.*, Fig. 2.

124. Kawakami discloses that the frame transmitting apparatus transmits

communications differently according to their Quality of Service (QoS) requirements. *Id.*, ¶[0037]. For example, Kawakami discloses that communications that can tolerate some delay but cannot tolerate errors are transmitted using retransmission; whereas, communications that can tolerate some errors but cannot tolerate delay such as voice communications are transmitted without retransmission. *Id.* Kawakami refers to the first type of communications as acknowledgement type and the second type of communications as unacknowledgement type. *Id.* Kawakami discloses that each message includes a header that identifies whether it is an acknowledgement type or unacknowledgement type message:

The frame building part 402 of the frame transmitting apparatus 40 is a part that divides a data packet, if necessary, to generate radio frames. The frame building part 402 divides a data packet to generate radio frames if the length of the data packet is longer than the maximum load length of radio frame. The frame building part 402 provides a header of each generated radio frame with a QoS identifier according to the QoS information described in the data packet or the QoS information of the connection forming the data flow. In general communication with a QoS level of tolerating some error but being strict on delay like voice communication or the like is handled so as not to perform retransmission. On the other hand, communication with a QoS level of tolerating some delay but not tolerating error like data communication is subjected to error correction by retransmission control. In the description hereinafter, a frame to request retransmission in conjunction with data

error or frame loss will be referred to as an acknowledgement type frame, and a frame without retransmission as an unacknowledgement type frame. The frame building part 402 sequentially provides acknowledgement type frames of one radio protocol connection with sequence numbers. The frame building part 402 outputs acknowledgement type frames to the retransmission management part 403 and outputs unacknowledgement type frames to the error detection code providing part 404.

*Id.*

125. Kawakami discloses that acknowledgement type messages are stored in a retransmission buffer while unacknowledgement type messages are not:

Referring back to FIG. 2, the retransmission management part 403 is a part that buffers an acknowledgement type frame for retransmission and, when receiving a request from the frame receiving apparatus 50, outputs a corresponding acknowledgement type frame to the error detection code providing part 404. The retransmission management part 403 starts a retransmission timer at the same time as transmission of a frame, and buffers the frame for retransmission before receiving an acknowledgement response (ACK) from the frame receiving apparatus. When receiving an ACK, the retransmission management part 403 discards the buffered frame. When detecting a timeout of the retransmission timer or detecting a frame loss from a sequence number of an ACK, the retransmission management part 403 outputs the buffered frame to the error detection code providing part 404.

*Id.*, ¶[0039].



**2. Reynders, D., Wright, E., “Practical TCP/IP and Ethernet Networking” (2003) (“Reynders”) (Ex. 1005)**

126. Reynders, titled “Practical TCP/IP and Ethernet Networking,” was published in 2003. *Id.*, copyright page (unnumbered). I am informed that Reynders qualifies as prior art under 35 U.S.C. §102(b) because it was published more than one year before the priority date of the ’055 patent.

127. I understand that Reynders was not cited during prosecution of the ’055 patent and was therefore not considered by the examiner.

128. Reynders describes itself as a “hands-on book that has been structured to cover the main areas of TCP/IP and Ethernet in detail, while going through the practical implementation of TCP/IP in computer and industrial applications,” directed towards a broad audience of specialists including “[n]etwork technicians,” “[c]ommunications specialists,” “[n]etwork planners,” and “[s]ystems engineers”. *Id.*, xvii. It provides a broad overview of the essentials of communications systems, networking fundamentals, and the operation of TCP/IP and Ethernet networks. *Id.*, xviii.

129. Reynders notes that the book is intended to teach readers how to:

- Understand the fundamentals of the TCP/IP suite of protocols
- Gain a practical understanding of the application of TCP/IP

- Learn how to construct a robust local area network (LAN)
- Learn the basic skills in troubleshooting TCP/IP and LANs
- Apply the TCP/IP suite of protocols to both an office and industrial environment

*Id.*, xvii.

130. I note that because Reynders is a primer on TCP/IP and related concepts, its disclosures reflect the general knowledge in the art as of its publication in 2003 and would have been common knowledge to a person having ordinary skill in the art, although of course its description of the field is not comprehensive.

131. Reynders states the following with respect to TCP/IP:

One of the great protocols that has been inherited from the Internet is TCP/IP and this is being used as the open standard today for all network and communications systems. The reasons for this popularity are not hard to find. TCP/IP and Ethernet are truly open standards available to competing manufacturers and providing the user with a common standard for a variety of products from different vendors. In addition, the cost of TCP/IP and Ethernet is low. Initially TCP/IP was used extensively in military applications and the purely commercial world such as banking, finance, and general business. But of great interest has been the strong movement to universal usage by the hitherto disinterested industrial and manufacturing spheres of activity who have traditionally used their own proprietary protocols and standards. These proprietary standards have been

almost entirely replaced by the usage of the TCP/IP suite of protocols.

*Id.*, xvii.

132. Reynders describes the decades-long history of TCP/IP as follows:

In the early 1960s The US **Department Of Defense** (DOD) indicated the need for a wide-area communication system, covering the United States and allowing the interconnection of heterogeneous hardware and software systems.

In 1967 the Stanford Research Institute was contracted to develop the suite of protocols for this network, initially to be known as ARPANet. Other participants in the project included the University of Berkeley (California) and the private company BBN (Bolt, Barenek and Newman). Development work commenced in 1970 and by 1972 approximately 40 sites were connected via TCP/IP. In 1973 the first international connection was made and in 1974 TCP/IP was released to the public.

Initially the network was used to interconnect governments; military and educational sites together. Slowly, as time progressed, commercial companies were allowed access and by 1990 the backbone of the Internet, as it was now known, was being extended into one country after the other.

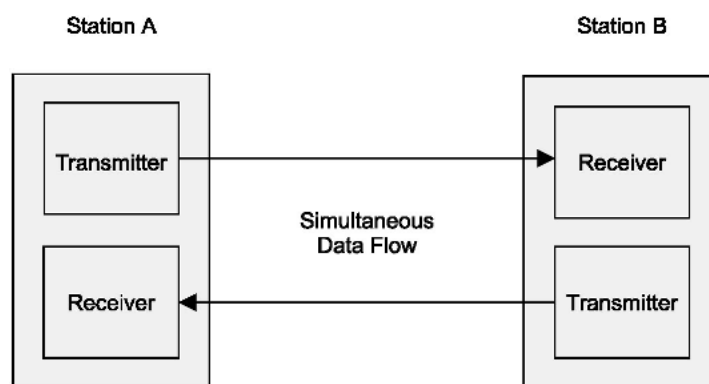
One of the major reasons why TCP/IP has become the *de facto* standard world-wide for industrial and telecommunications applications is the fact that the Internet was designed around it in the first place and that, without it, no Internet access is possible.

*Id.*, 74.

133. Reynders discloses that TCP/IP protocols can be implemented using

transceivers. Specifically, Reynders discloses that a typical communications network would comprise many devices that are “transceivers” under the claim construction that I have applied. Examples include:

- Reynders discloses that communications networks may contain a “full-duplex channel that gives simultaneous communications in both directions,” with each station capable of transmitting and receiving data:



Reynders, Fig. 1.11 (“Full-duplex transmission”). A person having ordinary skill in the art would have understood that each station contains shared circuitry, as it is depicted as a single electronic device.

- Reynders discloses that communications networks include “a communications path between one or more computers, file-servers, terminals, workstations and various other intelligent peripheral

equipment, which are generally referred to as devices or hosts.” *Id.*,

15. Any of these devices can “transmit data” and “receive... data on the network.” *Id.*, 16. A person having ordinary skill in the art would have understood that each of these devices (e.g. computers, file-servers, terminals, workstations) contains circuitry shared across the whole of the device, including the portions responsible for receiving and transmitting data.

- Reynders discloses that devices may be connected to the Internet—i.e., may transmit and receive data over the Internet, including TCP/IP data—through routers, point-to-point protocol servers, modems, or “integrated access servers, with the routing, dial-up server and modem functions in one box.” *Id.*, 199. A person having ordinary skill in the art would have understood that each of these devices contains shared circuitry responsible for receiving and transmitting data.

134. Reynders discloses that data communications are typically broken down into a hierarchy of layers. Reynders, 21. Reynders explains that “[e]ach layer has a defined purpose and interfaces with the layers above it and below it.” *Id.*

The layers are abstract in that the “actual functions within each layer are provided

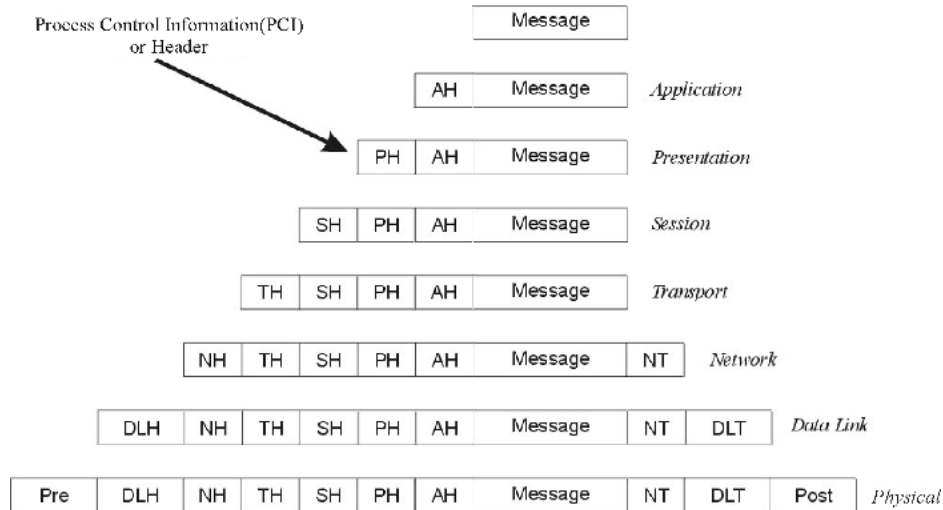
by entities which are abstract devices, such as programs, functions, or protocols, that implement the services for a particular layer on a single machine.” For example, the open systems interconnection reference model (“OSI”) includes seven layers as shown in Figure 2.7:



*Id.*, Fig. 2.7 (“The OSI reference model”).

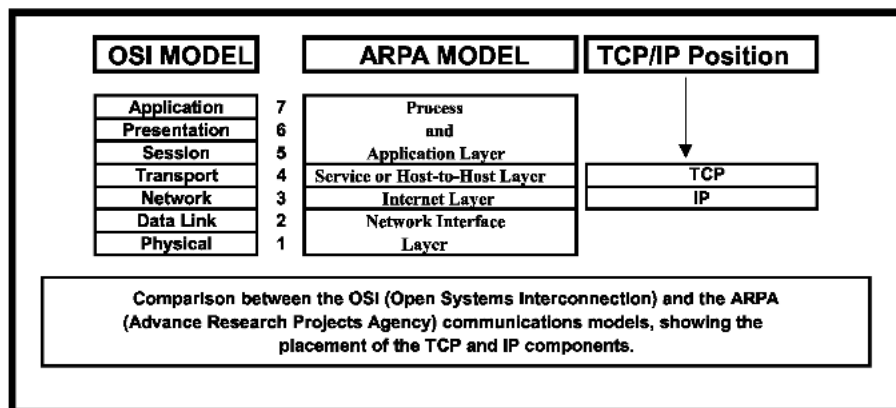
135. Reynders explains that “each layer in the transmitting site, with the exception of the lowest, adds header information, or protocol control information (PCI), to the data before passing it through the interface between adjacent layers.”

*Id.*, 23. Reynders illustrates this concept in Figure 2.10:



*Id.*, Fig. 2.10 (“OSI message passing”).

136. Reynders discusses another reference model, the ARPA model. *Id.*, 75. Reynders discloses that ARPA model is similar to the OSI model, but the ARPA model has only 4 layers. *Id.* In Figure 5.1, Reynders illustrates how the layers in each model correspond and where the TCP/IP protocol resides in the layered architecture:



*Id.*, Fig. 5.1 (“OSI vs ARPA models”).

137. Reynders explains that the TCP/IP protocol suite “is not limited to

the TCP and IP protocols, but consist of a multitude of interrelated protocols that occupy the upper three layers of the ARPA model.” *Id.*, 75.

138. Reynders discusses the layers of the TCP/IP protocol suite—the internet layer, the host-to-host layer, and the process and application layer. *Id.*, 75-77. Reynders explains that the internet layer “is primarily responsible for the routing of packets from one host to another,” and that “the dominant protocol... is the IP (as in TCP/IP), namely the Internet protocol.” *Id.*, 76. A person having ordinary skill in the art would have understood this reference to the “Internet protocol” to refer to RFC 791, titled “Internet Protocol.”

139. For the host-to-host layer, Reynders explains that this layer “is primarily responsible for data integrity between the sender host and receiver host regardless of the path or distance used to convey the message” and that “[c]ommunications errors are detected and corrected at this level.” *Id.*, 76.

Reynders discloses that the host-to-host layer has “two protocols associated with it, these being:”

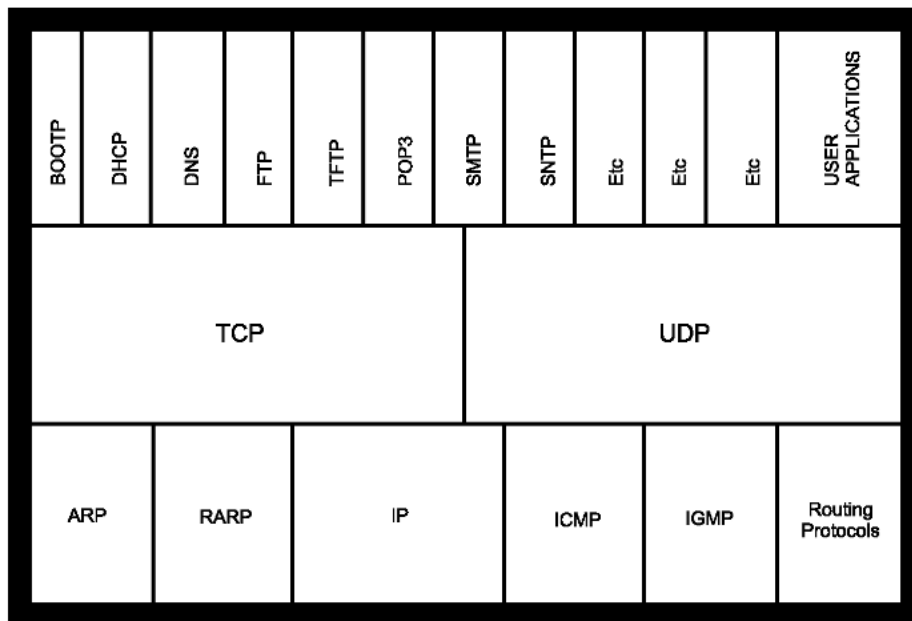
- **User data protocol (UDP).** This is a connectionless (unreliable) protocol used for higher layer port addressing. It offers minimal protocol overhead and is described in RFC 768
- **Transmission control protocol (TCP).** This is a connection-oriented protocol that offers vastly improved protection and error control. This



protocol, the TCP component of TCP/IP, is the heart of the TCP/IP suite of applications. It provides a very reliable method of transferring data in byte (octet) format, between applications. This is described in RFC 793.

*Id.*, 76-77.

140. Reynders shows the three layers of the TCP/IP protocol suite including the IP and TCP protocols in Figure 5.2:

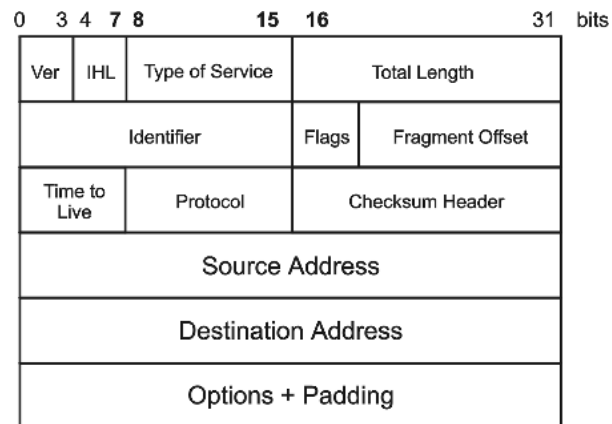


Reynders, Fig. 5.2 (“The TCP/IP protocol suite”).

141. Like the OSI model, Reynders explains that each layer in the TCP/IP protocol suite appends header information prior to the data prior to passing it to the next layer: “The **Internet protocol (IP)** is at the core of the TCP/IP suite. It is primarily responsible for routing packets towards their destination, from router to router. This routing is performed on the basis of the IP addresses, embedded in the

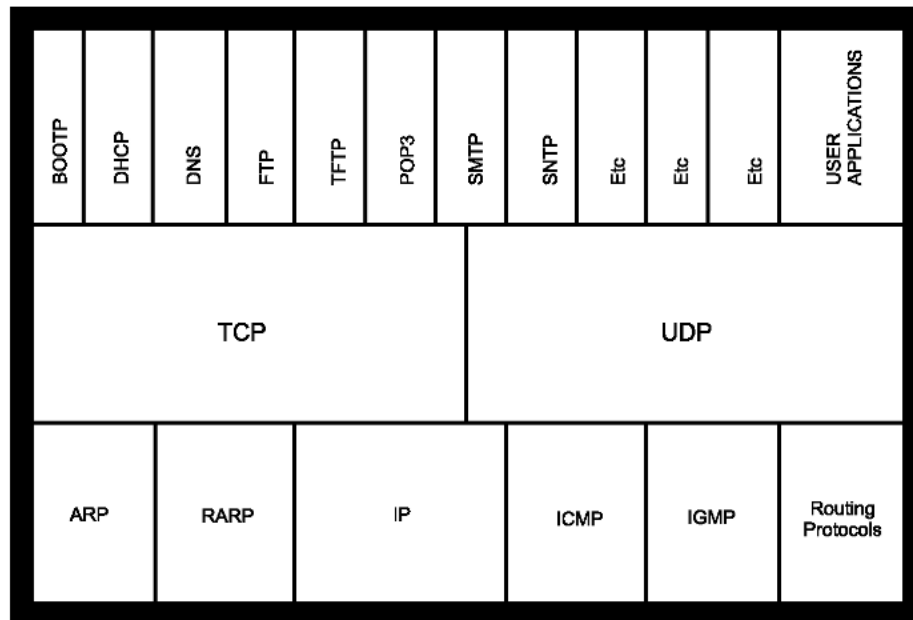
header attached to each packet forwarded by IP.” *Id.*, 79.

142. Reynders discloses the structure of the IP headers “appended to the data that IP accepts from higher-level protocols” in the IPv4 protocol:



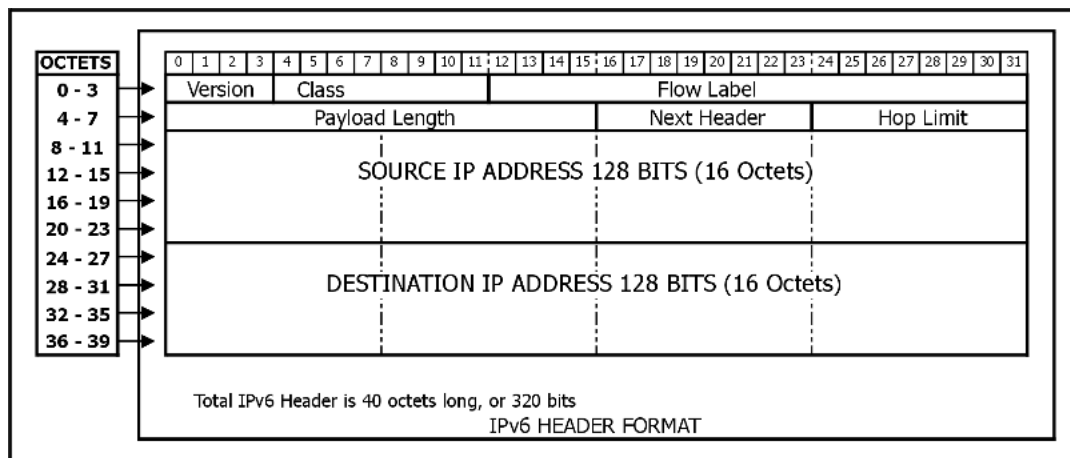
*Id.*, Fig. 6.13 (“IPv4 header”).

143. Reynders explains that the “Protocol” field in the IP header “indicates the next (higher) level protocol used in the data portion of the Internet datagram, in other words the protocol that resides above IP in the protocol stack and which has passed the datagram on to IP.” *Id.*, 92. A person having ordinary skill in the art would have understood that the protocol field indicates whether a packet is a TCP or UDP packet, as those protocols “reside[] above IP in the protocol stack”:



*Id.*, Fig. 5.2 (“The TCP/IP protocol suite”).

144. Reynders also discusses the possible future implementation of the new IPv6 protocol. *Id.*, 94. An IPv6 header has the following fields:



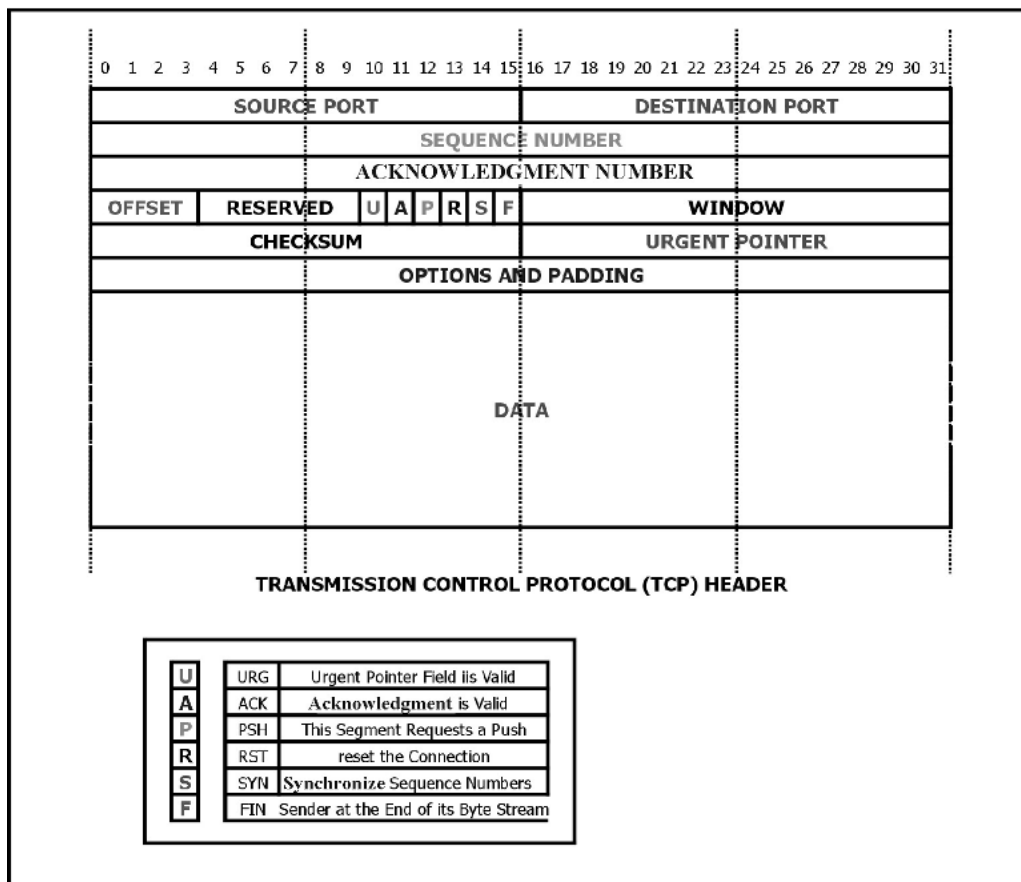
*Id.*, Fig. 6.17 (“IPv6 header”). The “Next Header” field in the IPv6 header, like the “Protocol” field in the IPv4 header, “identifies the type of header immediately following the IPv6 header,” which could include TCP or UDP. *Id.*, 96.

145. Reynders describes the TCP protocol as follows:

TCP is a connection-oriented protocol and is therefore reliable, although this word is used in a data communications context and not in an everyday sense. TCP establishes a connection between two hosts before any data is transmitted. Because a connection is set up beforehand, it is possible to verify that all packets are received on the other end and to arrange re-transmission in the case of lost packets. Because of all these built-in functions, TCP involves significant additional overhead in terms of processing time and header size.

*Id.*, 123.

146. Reynders discloses that a TCP header includes the following fields:



*Id.*, Fig. 7.5 (“TCP frame format”).

147. Reynders discloses the following with respect to the “Sequence Number” field in a TCP header:

A fundamental notion in the TCP design is that every BYTE of data sent over the TCP connection has a unique 32-bit sequence number. Of course this number cannot be sent along with every byte, yet it is nevertheless implied. However, the sequence number of the FIRST byte in each segment is included in the accompanying TCP header, for each subsequent byte that number is simply incremented by the receiver in order to keep track of the bytes.

*Id.*, 124.

148. Reynders discloses that the sequence number of a TCP packet header is used to confirm receipt of that data by the receiving system. *Id.*, 124-125. If a data packet is successfully received by the receiving system, the receiving system will send an acknowledgement number (ACK) to the transmitting system, confirming receipt. *Id.*, 125-127. If an ACK is not received “within a given time,” “another copy of the message will be transmitted,” a technique known as “positive acknowledgement with retransmission.” *Id.*, 125. I note that for this process to take place, both the transmitting and the receiving systems must be capable of transmitting and receiving data.

149. Reynders describes the UDP protocol as follows:

The second protocol that occupies the host-to-host layer is UDP. As in the case of TCP, it makes use of the underlying IP protocol to deliver its datagrams.

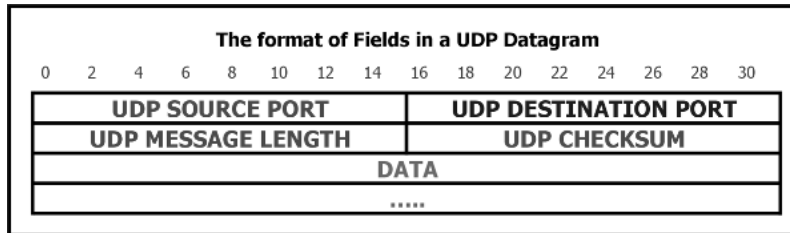
UDP is a ‘connectionless’ or non-connection-oriented protocol and does not require a connection to be established between two machines prior to data transmission. It is therefore said to be an ‘unreliable’ protocol – the word ‘unreliable’ used here as opposed to ‘reliable’ in the case of TCP.

As in the case of TCP, packets are still delivered to sockets or ports. However, no connection is established beforehand and therefore UDP cannot guarantee that packets are retransmitted if faulty, received in the correct sequence, or even received at all. In view of this, one might doubt the desirability of such an unreliable protocol. There are, however, some good reasons for its existence.

Sending a UDP datagram involves very little overhead in that there are no synchronization parameters, no priority options, no sequence numbers, no retransmit timers, no delayed acknowledgement timers, and no retransmission of packets. The header is small; the protocol is quick, and streamlined functionally. The only major drawback is that delivery is not guaranteed. UDP is therefore used for communications that involve broadcasts, for general network announcements, or for real-time data. A particularly good application is with streaming video and streaming audio where low transmission overheads are a prerequisite, and where retransmission of lost packets is not only unnecessary but also definitely undesirable.

*Id.*, 131. Of relevance to the ’055 packet, Reynders discloses that UDP involves “no retransmission of packets.” *Id.*

150. Reynders discloses that a UDP header contains the following fields:



*Id.*, Fig. 7.7 (“UDP frame format”). Of relevance to the ’055 patent, a UDP header does not contain a sequence number.

### 3. RFC 791, “Internet Protocol,” September 1981 (Ex. 1006)

151. RFC 791, titled “Internet Protocol,” was published in September 1981. *Id.*, cover page (unnumbered). RFC 791 is the foundational document setting forth the IP protocol that was essential for the operation of the Internet as of the priority date of the ’055 patent, and is still essential to this day. *See, e.g.*, Reynders, 74, 76.

152. The operation of the Internet as well as TCP/IP intranets is built on the foundation of the Internet Protocol, defined by RFC 791. As such, a person having ordinary skill in the art designing, using, or seeking to understand TCP/IP networks would look to RFC 791.

153. I am informed that RFC 791 qualifies as prior art under 35 U.S.C. §102(b) because it was published more than one year before the priority date of the ’055 patent.

154. I understand that RFC 791 was not cited during prosecution of the

'055 patent and was therefore not considered by the examiner.

155. RFC 791 depicts the Internet protocol hierarchy, with TCP/UDP as the layer above IP:

The following diagram illustrates the place of the internet protocol in the protocol hierarchy:

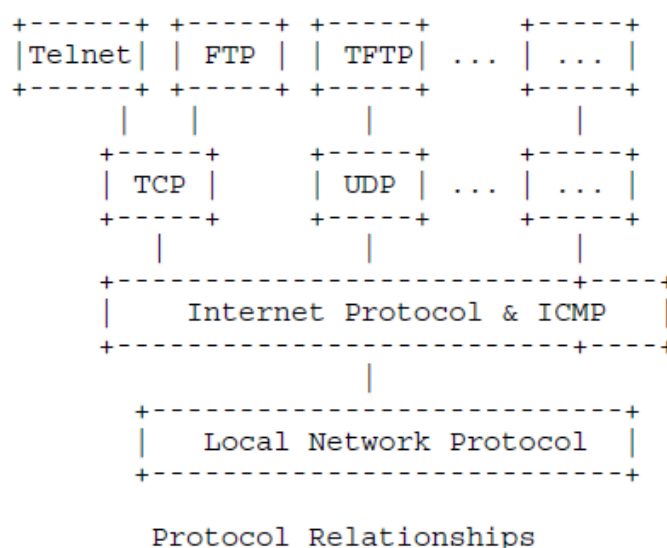


Figure 1.

RFC 791, Fig. 1.

156. RFC 791 explains that the IP protocol is designed to work in combination with the TCP layer, with each layer providing its own headers:

This protocol is called on by host-to-host protocols in an internet environment. This protocol calls on local network protocols to carry the internet datagram to the next gateway or destination host.

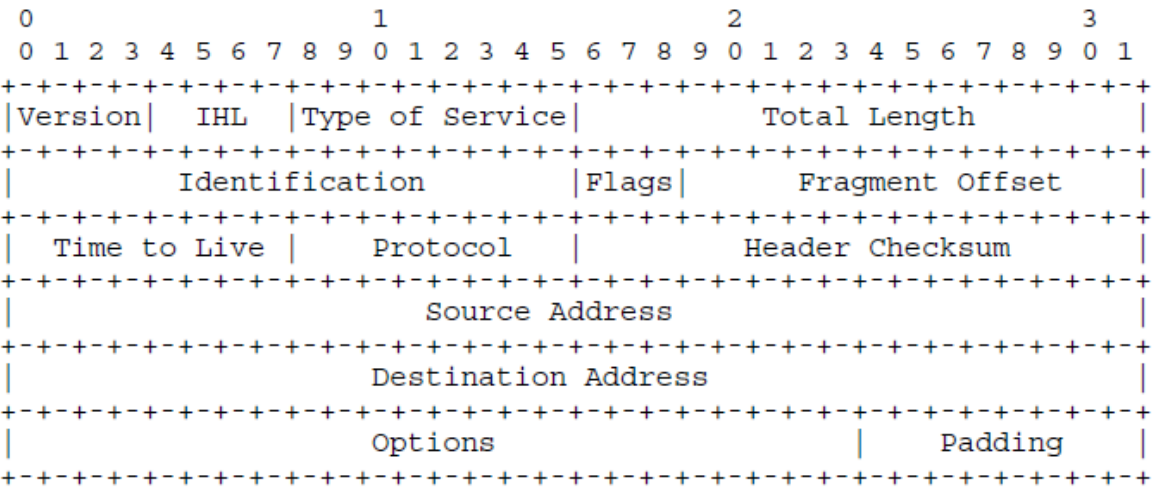
For example, a TCP module would call on the internet module to take a TCP segment (including the TCP header



and user data) as the data portion of an internet datagram. The TCP module would provide the addresses and other parameters in the internet header to the internet module as arguments of the call. The internet module would then create an internet datagram and call on the local network interface to transmit the internet datagram.

*Id.*, 1.

157. RFC 791 explains that an IP header contains the following fields:



Example Internet Datagram Header

Figure 4.

*Id.*, Fig. 4.

158. RFC 791 discloses that the “Protocol” field “indicates the next level protocol used in the data portion of the internet datagram,” and that the “values for various protocols are specified in ‘Assigned Numbers’,” citing to RFC 790. A person having ordinary skill in the art would have understood that the “next level protocol” would be TCP or UDP, as depicted in the hierarchy of protocols. RFC

791, 5. I note that in RFC 790, “Assigned Numbers” (September 1981), the assigned numbers for the Protocol field are specified; decimal 6 indicates TCP, and decimal 17 indicates “User Datagram” (i.e., UDP). RFC 790, 6.

**4. RFC 793, “Transmission Control Protocol,” September 1981 (Ex. 1007)**

159. RFC 793, titled “Transmission Control Protocol,” was published in September 1981. *Id.*, cover page (unnumbered). RFC 793 is the foundational document setting forth the TCP protocol that was essential for the operation of the Internet as of the priority date of the ’055 patent, and is still essential to this day. *See, e.g.*, Reynders, 74, 76.

160. While RFC 791 defines the Internet Protocol (IP), RFC 793 defines the Transmission Control Protocol (TCP). IP defines interaction between adjacent nodes in a TCP/IP network, while the “higher level” TCP specification describes how IP packets are transmitted across networks. TCP includes so-called end-to-end functions such as flow control to manage network congestion. A person having ordinary skill in the art would recognize that, as the name suggests, a TCP/IP network would include both IP and TCP functionality and RFC 793 defines the TCP foundation.

161. I am informed that RFC 793 qualifies as prior art under 35 U.S.C. §102(b) because it was published more than one year before the priority date of the

'055 patent.

162. I understand that RFC 793 was not cited during prosecution of the '055 patent and was therefore not considered by the examiner.

163. RFC 793 states the following in its introduction:

The Transmission Control Protocol (TCP) is intended for use as a highly reliable host-to-host protocol between hosts in packet-switched computer communication networks, and in interconnected systems of such networks.

This document describes the functions to be performed by the Transmission Control Protocol, the program that implements it, and its interface to programs or users that require its services.

RFC 793, 1.

164. RFC 793 states that “TCP fits into a layered protocol architecture just above a basic Internet Protocol,” citing to RFC 791. *Id.* It depicts the protocol layering as follows:

### Protocol Layering

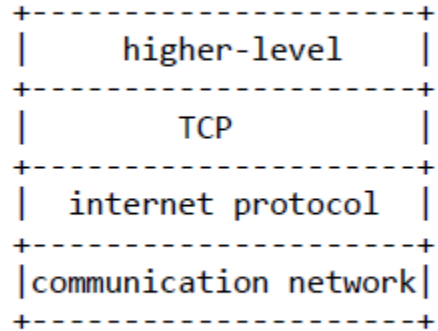
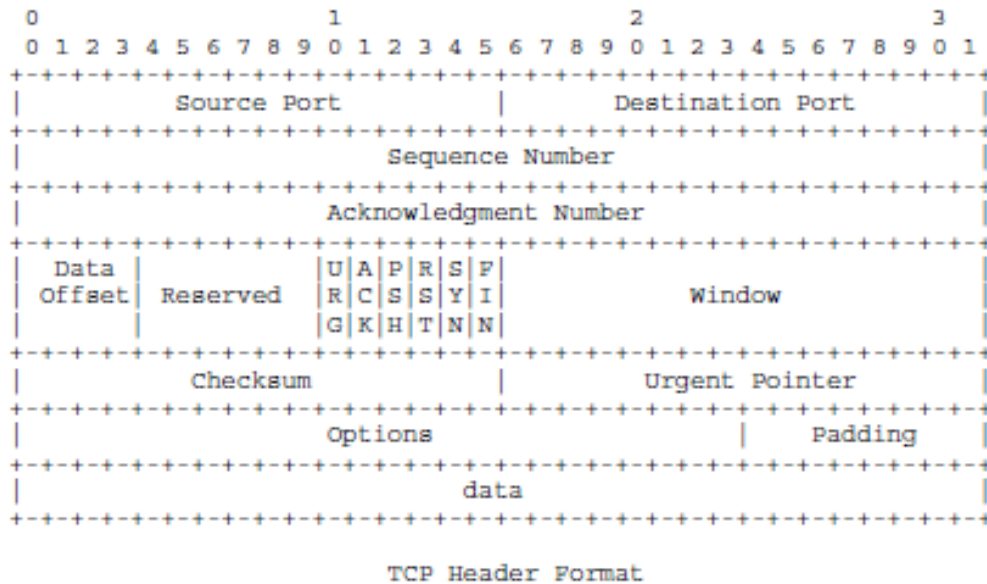


Figure 1

*Id.*, Fig. 1.

165. RFC 793 discloses that a TCP header contains the following fields:



TCP Header Format

Note that one tick mark represents one bit position.

Figure 3.

*Id.*, Fig. 3.

166. With respect to sequence numbers, RFC 793 discloses that the

sequence number is “incremented for each octet of data or sequenced control transmitted” to establish “the next sequence number the local (sending) TCP will use on the connection.” *Id.*, 83.

167. RFC 793 states the following with respect to reliability of the system:

The TCP must recover from data that is damaged, lost, duplicated, or delivered out of order by the internet communication system. This is achieved by assigning a sequence number to each octet transmitted, and requiring a positive acknowledgment (ACK) from the receiving TCP. If the ACK is not received within a timeout interval, the data is retransmitted. At the receiver, the sequence numbers are used to correctly order segments that may be received out of order and to eliminate duplicates. Damage is handled by adding a checksum to each segment transmitted, checking it at the receiver, and discarding damaged segments.

*Id.*, 4.

168. RFC 793 further discloses the following, with respect to its mechanism of transmission:

A stream of data sent on a TCP connection is delivered reliably and in order at the destination.

Transmission is made reliable via the use of sequence numbers and acknowledgments. Conceptually, each octet of data is assigned a sequence number. The sequence number of the first octet of data in a segment is transmitted with that segment and is called the segment sequence number. Segments also carry an acknowledgment number which is the sequence number of the next expected data octet of transmissions in the

reverse direction. When the TCP transmits a segment containing data, it puts a copy on a retransmission queue and starts a timer; when the acknowledgment for that data is received, the segment is deleted from the queue. If the acknowledgment is not received before the timer runs out, the segment is retransmitted.

*Id.*, 9-10. I note that a person having ordinary skill in the art would have understood a “retransmission queue” to be a synonym for a “retransmission buffer.” *See, e.g.*, Park, J., Yoon, Y., Lee, S., “An Extended TCP/IP Protocol Over the Local Area Network for DCCS,” IFAC Proceedings Volume 30, Issue 15, pp. 97-104 (July 1997) (“Park”) (Ex. 1022), 100 (noting that “[s]tandard TCP process” has a “retransmission buffer”); Smith, M., Ramakrishnan, K., “Formal Specification and Verification of Safety and Performance of TCP Selective Acknowledgment,” III/ACM Transactions on Networking, Vol. 10, No. 2, pp. 193-207 (April 2002) (Ex. 1023), 194 (in TCP, “[d]ata that is transmitted is kept on a retransmission buffer until it has been acknowledged”).

169. RFC 793 discloses that computers attached to the communication network can both transmit and receive packets:

Hosts are computers attached to a network, and from the communication network's point of view, are the sources and destinations of packets.

RFC 793, 7.

**5. RFC 768, “User Datagram Protocol,” August 28, 1980 (Ex. 1008)**

170. RFC 768, titled “User Datagram Protocol,” was published on August 28, 1980. *Id.*, cover page (unnumbered). RFC 768 is the foundational document setting forth the UDP protocol that was essential for the operation of the Internet as of the priority date of the ’055 patent, and is still essential to this day. *See, e.g.*, Reynders, 74, 76.

171. As described above, TCP is a protocol that relies on an IP infrastructure and provides a means to provide retransmission of user information. It does so at the expense of additional transmission delay where errored transmissions must be repeated. In contrast, UDP provides a corresponding protocol where low latency is more important than error free transmission. A person having ordinary skill in the art would have recognized that RFC 768 is the defining document needed to understand UDP, just as RFC 791 and 793 define IP and TCP.

172. I am informed that RFC 768 qualifies as prior art under 35 U.S.C. §102(b) because it was published more than one year before the priority date of the ’055 patent.

173. I understand that RFC 768 was not cited during prosecution of the ’055 patent and was therefore not considered by the examiner.

174. RFC 768 introduces the purpose of the User Datagram Protocol

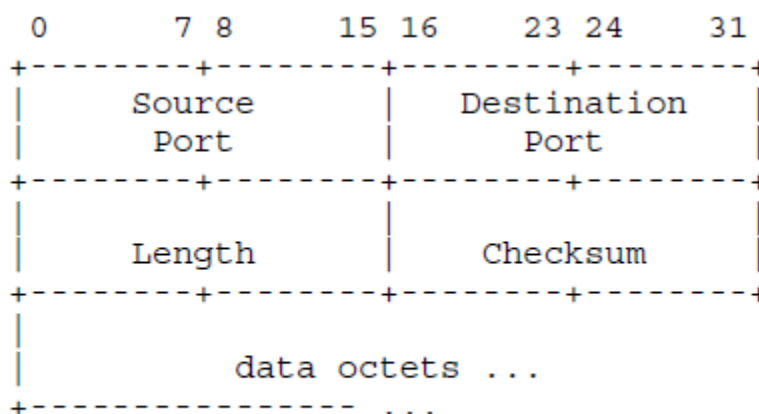
(UDP) as follows:

This User Datagram Protocol (UDP) is defined to make available a datagram mode of packet-switched computer communication in the environment of an interconnected set of computer networks. This protocol assumes that the Internet Protocol (IP) is used as the underlying protocol.

This protocol provides a procedure for application programs to send messages to other programs with a minimum of protocol mechanism. The protocol is transaction oriented, and delivery and duplicate protection are not guaranteed. Applications requiring ordered reliable delivery of streams of data should use the Transmission Control Protocol (TCP).

RFC 768, 1 (footnotes omitted).

175. RFC 768 discloses that UDP headers contain the following fields:



User Datagram Header Format

*Id.*, 1. In contrast to TCP headers, UDP headers do not contain a sequence number.

*See id.*



176. RFC 768 discloses that UDP is “protocol 17 (21 octal) when used in the Internet Protocol,” referring to the IP header “protocol” field. *Id.*, 3.

**B. Ground 1: Claims 1, 5, 10, 11, 15, and 20 are unpatentable as obvious under 35 U.S.C. §103(a) in view of Kawakami (Ex. 1004).**

177. It is my opinion that Kawakami renders obvious claims 1, 5, 10, 11, 15, and 20 of the '055 patent because Kawakami discloses and renders obvious each limitation of claims 1, 5, 10, 11, 15, and 20.

**1. Independent Claim 1**

**a. “A method of packet retransmission, in a transceiver, comprising:” (Claim 1[pre])**

178. In my opinion, Kawakami discloses and renders obvious “[a] method of packet retransmission, in a transceiver.”

179. A transceiver has been construed to be a “communications device capable of transmitting and receiving data wherein the transmitter portion and receiver portion share at least some common circuitry.” Claim Construction Order, 2.

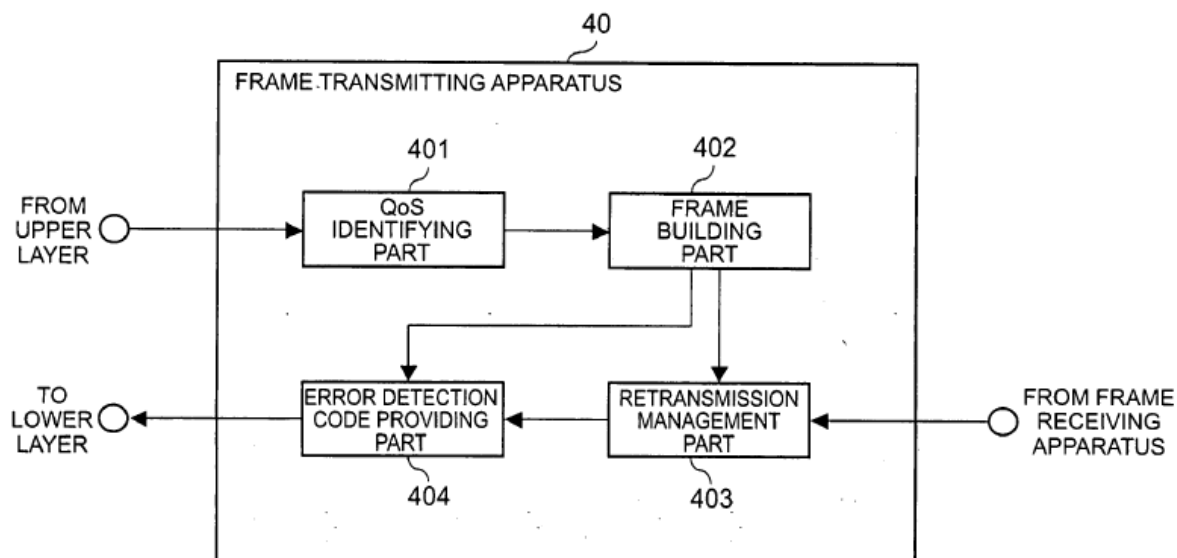
180. Kawakami discloses a transceiver, namely mobile station 20 and control station 102. Kawakami, Fig. 1, ¶[0032].

181. Kawakami discloses that the mobile station and control station are each capable of transmitting and receiving data. For example, Kawakami discloses that the mobile station includes a “frame transmitting apparatus” and that the

control station includes a “frame receiving apparatus.” *Id.*, ¶[0034] (“In the description of the frame transmitting apparatus 40 and frame receiving apparatus 50 below, it is assumed that the frame transmitting apparatus 40 is placed in the mobile station 20 and the frame receiving apparatus 50 in the radio link control station 102.”).

182. Kawakami illustrates the frame transmitting apparatus of the mobile station in Figure 2:

**Fig.2**



*Id.*, Fig. 2. Figure 2 shows that the frame transmitting apparatus, in addition to being a transmitter, is also a receiver, as it is shown receiving data from the frame receiving apparatus of the control station. Figure 2 also shows that the transmitting

portions and receiving portions of the frame transmitting apparatus share at least some common circuitry, e.g., retransmission management part 403. Kawakami makes this explicitly clear in the specification:

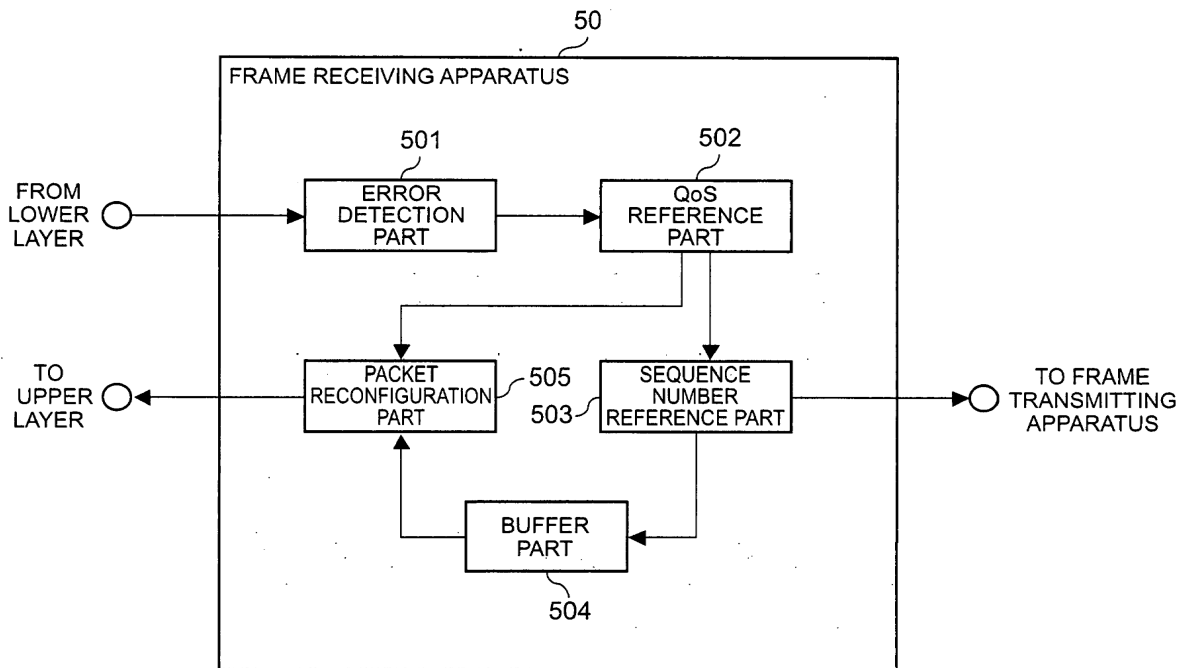
The frame building part 402 of the frame transmitting apparatus 40 is a part that divides a data packet, if necessary, to generate radio frames....The frame building part 402 outputs acknowledgement type frames to the retransmission management part 403 and outputs unacknowledgement type frames to the error detection code providing part 404.

Referring back to FIG. 2, the retransmission management part 403 is a part that buffers an acknowledgement type frame for retransmission and, when receiving a request from the frame receiving apparatus 50, outputs a corresponding acknowledgement type frame to the error detection code providing part 404.

*Id.*, ¶¶ [0037], [0039] (emphasis added).

183. Kawakami illustrates the frame receiving apparatus of the control station in Figure 3:

**Fig.3**



*Id.*, Fig. 3. Figure 3 shows that the frame receiving apparatus is both a receiver and a transmitter, as it is illustrated sending data to the frame transmitting apparatus.

The figure also shows that at least the sequence number reference part is shared between the receiving and transmitting portions of the frame receiving apparatus.

The specification confirms that the sequence number reference part has both receiving and transmitting functions:

The sequence number reference part 503 is a part that refers to a sequence number of each acknowledgement type frame and that transmits an ACK with the sequence number to the frame transmitting apparatus 40. The sequence number reference part 503 also outputs an acknowledgement type frame outputted from the QoS

reference part 502, to the buffer part 504. Furthermore, the sequence number reference part 503 refers to a sequence number of each acknowledgement type frame and, when detecting a frame loss with a sequence number drop, instructs the buffer part 504 to buffer an acknowledgement type frame received thereafter.

*Id.*, ¶[0044] (emphasis added).

184. Accordingly, in my opinion, both the mobile station and the control station of Kawakami are “transceivers” in accordance with the court’s construction.

185. To the extent that Kawakami does not explicitly disclose that the transmitting and receiving portions of the mobile station and the control station share at least some common circuitry, a person having ordinary skill in the art would have understood that they do. For example, a person having ordinary skill in the art would have been aware that mobile communication systems routinely used shared circuitry for their transmitting and receiving components. *See, e.g.*, U.S. Patent No. 7,016,658 (Ex. 1024), Figs. 3-4 (showing shared controller between transmitter and receiver in a CDMA mobile communications system); U.S. Pat. App. Pub. No. 2006/0039330 (“Hackett”) (Ex. 1025), Fig. 3 (depicting a transceiver having a transmitter and a receiver, and several common components, such as the “Host CPU” and the “Timing and Sync Unit” in a mobile communications system). The stations described here are capable of transmitting

and receiving information and, in general, will have some components shared between the two functions, meeting the Court's construction of a transceiver.

186. Kawakami discloses a method of packet retransmission in the mobile station and control station. *See, e.g.*, Kawakami, ¶[0033] (“When the mobile station 20 requests the mobile communication network 10 to perform communication for transfer of packet, a radio protocol connection is established between the mobile station 20 and the radio link control station 102. The radio protocol has the functions of generating radio frames and performing the retransmission control.”).

187. Accordingly, to the extent it is limiting, Kawakami discloses and renders obvious claim 1[pre].

**b. “transmitting, by the transceiver, a first type of packet;” (Claim 1[a])**

188. Kawakami discloses and renders obvious transmitting, by the mobile station (transceiver), a first type of packet.

189. Kawakami discloses transmitting different types of packets according to their Quality of Service (QoS). *See, e.g.*, Kawakami, ¶¶[0012]-[0020] (describing a “frame transmitting apparatus used in a frame transmission/reception system for transferring a data packet on a connection established prior to communication” which transmits “frames” (i.e., packets) which contain “a QoS

identifier... with information for determining whether the frame is an acknowledgement type frame” and transmit it to a “frame receiving apparatus”). Kawakami explains that a first type of packet is an “acknowledgement type frame,” i.e., a packet with a “QoS level of tolerating some delay but not tolerating error like data communication.” *Id.*, ¶[0037].

190. Accordingly, Kawakami discloses and renders obvious claim 1[a].

**c. “transmitting, by the transceiver, a second type of packet” (Claim 1[b])**

191. Kawakami discloses and renders obvious transmitting, by the mobile station (transceiver), a second type of packet.

192. Kawakami discloses different types of packets according to their Quality of Service (QoS). *See, e.g.*, Kawakami, Kawakami, ¶[0012]-[0020] (describing a “frame transmitting apparatus used in a frame transmission/reception system for transferring a data packet on a connection established prior to communication” which transmits “frames” (i.e., packets) which contain “a QoS identifier... with information for determining whether the frame is an acknowledgement type frame” and transmit it to a “frame receiving apparatus”). Kawakami explains that a second type of packet is an “unacknowledgement type frame,” i.e. a packet with a “QoS level of tolerating some error but being strict on delay like voice communication or the like.” *Id.*, ¶[0037].

193. Accordingly, Kawakami discloses and renders obvious claim 1[b].

- d. “wherein the first type of packet is stored in a retransmission buffer after transmission and the second type of packet is not stored in a retransmission buffer after transmission” (Claim 1[c])**

194. Kawakami discloses and renders obvious that an acknowledgement type packet (first type of packet) is stored in a retransmission buffer after transmission and that an unacknowledgement type packet (second type of packet) is not stored in a retransmission buffer after transmission.

195. Kawakami explains that a packet with a “QoS level of tolerating some delay but not tolerating error like data communication is subjected to error correction by retransmission control.” *Id.*, ¶[0037]. Kawakami also explains that a packet with a “QoS level of tolerating some error but being strict on delay like voice communication or the like is handled so as not to perform retransmission.” *Id.*, ¶[0037]. Kawakami refers to the first type of packet as an “acknowledgement type” packet and the second type of packet as an “unacknowledgement type” packet. *Id.* Kawakami discloses that acknowledgement type packets are stored in a retransmission buffer and that unacknowledgement type packets are not. *Id.*, ¶[0039] (“Referring back to FIG. 2, the retransmission management part 403 is a part that buffers an acknowledgement type frame for retransmission and, when receiving a request from the frame receiving apparatus 50, outputs a corresponding



acknowledgement type frame to the error detection code providing part 404. The retransmission management part 403 starts a retransmission timer at the same time as transmission of a frame, and buffers the frame for retransmission before receiving an acknowledgement response (ACK) from the frame receiving apparatus.”); ¶[0037] (“The frame building part 402 outputs acknowledgement type frames to the retransmission management part 403 and outputs unacknowledgement type frames to the error detection code providing part 404.”).

196. Therefore, Kawakami discloses and renders obvious claim 1[c].

- e. **“wherein the first and second types of packet comprise a header field that indicates whether a transmitted packet is a first type of packet or a second type of packet” (Claim 1[d])**

197. Kawakami discloses and renders obvious that an acknowledgement type packet (first type of packet) and an unacknowledgement type packet (second type of packets) each include a header field that indicates the type of packet.

198. Kawakami discloses that acknowledgement type packets and unacknowledgement type packets include a header that indicates the type of packet. *See, e.g.*, Kawakami, ¶[0037] (“The frame building part 402 provides a header of each generated radio frame with a QoS identifier according to the QoS information described in the data packet or the QoS information of the connection forming the data flow.”); ¶[0038] (“In the example of FIG. 4 (a), the QoS identifier

of ‘0’ indicates an unacknowledgement type frame, and the QoS identifier of ‘1’ an acknowledgement type frame.”). The header of Kawakami’s packets therefore contains a header field that indicates whether the transmitted packet is the first type of packet (acknowledgement type frame) or a the second type of packet (unacknowledgement type frame): a QoS identifier in the header which is 0 for unacknowledgement type frames, and which is 1 for acknowledgement type frames. *See id.*

199. Accordingly, Kawakami discloses and renders obvious claim 1[d].

**f. “wherein the header field of the first type of packet comprises a sequence identifier (SID) that is incremented after the first type of packet is transmitted and the header field of the second type of packet does not comprise the SID of the first type of packet.” (Claim 1[e])**

200. Kawakami discloses and renders obvious that the header field of an acknowledgement type packet (first type of packet) includes a sequence identifier (SID) that is incremented after the acknowledgement type packet is transmitted and that the header field of an unacknowledgement type packet (second type of packet) does not include such an SID.

201. Kawakami discloses that the header of an acknowledgement type packet includes a sequence number (SID) that is incremented after transmission. Kawakami, §(57, Abstract) (emphasis added) (“In order to achieve this object, a

frame receiving apparatus has a QoS reference part for identifying whether a frame is an acknowledgement type frame, based on a QoS identifier provided for each frame, and a sequence number reference part for determining whether a frame is lost, only for each acknowledgement type frame, and requesting retransmission of a lost frame.”); ¶[0015] (emphasis added) (“Preferably, the frame transmitting apparatus of the present invention comprises number providing means for providing each acknowledgement type frame with a sequence number for each established connection. Since acknowledgement type frames are provided with their respective sequence numbers, for example, a frame receiving apparatus is able to acknowledge a loss of an acknowledgement type frame from discontinuity of the sequence numbers.”); ¶[0037] (emphasis added) (“The frame building part 402 sequentially provides acknowledgement type frames of one radio protocol connection with sequence numbers.”); ¶[0044] (emphasis added) (“The sequence number reference part 503 is a part that refers to a sequence number of each acknowledgement type frame and that transmits an ACK with the sequence number to the frame transmitting apparatus 40. The sequence number reference part 503 also outputs an acknowledgement type frame outputted from the QoS reference part 502, to the buffer part 504. Furthermore, the sequence number reference part 503 refers to a sequence number of each acknowledgement type

frame and, when detecting a frame loss with a sequence number drop, instructs the buffer part 504 to buffer an acknowledgement type frame received thereafter.”).

202. A person having ordinary skill in the art would have understood that the sequence number disclosed by Kawakami is a “SID that is incremented” after transmission. A person having ordinary skill in the art would have also understood that the header field of an unacknowledgement type packet does not include a SID since Kawakami only discloses providing acknowledgement type frames with a SID and explains that the SID is used to “determine[e] whether a frame is lost, only for each acknowledgement type frame.” Kawakami, §(57), ¶[0037]. Thus, appending a SID on an unacknowledgement type frame would serve no purpose.

203. To the extent that Kawakami does not explicitly disclose that the header field of an acknowledgement type frame includes a SID that is “incremented” after the frame is transmitted, it would have been obvious to a person having ordinary skill in the art to do so. Appending a SID to a packet that is incremented after transmission is a fundamental part of all selective repeat retransmission systems that allows a receiving transceiver to determine if a frame was lost due to error, request that the frame be retransmitted, and the put the frames in the correct order after receiving the retransmitted frame.

204. Accordingly, Kawakami discloses and renders obvious claim 1[e].

205. Thus, Kawakami discloses and renders obvious all limitations of claim 1 and therefore renders claim 1 obvious.

## **2. Independent Claim 11**

206. Claim 11 is similar to claim 1, except that whereas claim 1 is directed to a method of packet retransmission in a transceiver, claim 11 is directed to a transceiver, which is operable to perform the method recited in claim 1.

207. As explained above, Kawakami renders obvious claim 1. As explained further below, Kawakami renders obvious claim 11 as well.

### **a. “A transceiver” (Claim 11 [pre])**

208. As explained above (§VI.B.1.a, *supra*), Kawakami discloses and renders obvious a transceiver.

209. Accordingly, to the extent it is limiting, Kawakami discloses and renders obvious claim 11[pre].

### **b. “operable to transmit a first type of packet and a second type of packet” (Claim 11[a])**

210. As explained above (§VI.B.1.b, VI.B.1.c, *supra*), Kawakami discloses and renders obvious that the mobile station (transceiver) is operable to transmit an acknowledgement type packet (first type of packet) and an unacknowledgement type packet (second type of packet).

211. Therefore, Kawakami discloses and renders obvious claim 11[a].

- c. **“wherein the first type of packet is stored in a retransmission buffer after transmission and the second type of packet is not stored in a retransmission buffer after transmission” (Claim 11[b])**

212. Claim element 11[b] recites the same claim element set forth in claim 1[c]. Therefore, claim element 11[b] is taught by Kawakami for the reasons explained above for claim element 1[c].

213. Accordingly, Kawakami discloses and renders obvious claim 11[b].

- d. **“wherein the first and second types of packet comprise a header field that indicates whether a transmitted packet is a first type of packet or a second type of packet” (Claim 11[c])**

214. Claim element 11[c] recites the same claim element set forth in claim 1[d]. Therefore, claim element 11[c] is taught by Kawakami for the reasons explained above for claim element 1[d].

215. Therefore, Kawakami discloses and renders obvious claim 11[c].

- e. **“wherein the header field of the first type of packet comprises a sequence identifier (SID) that is incremented after the first type of packet is transmitted and the header field of the second type of packet does not comprise the SID of the first type of packet” (Claim 11[d])**

216. Claim element 11[d] recites the same claim element set forth in claim 1[e]. Therefore, claim element 11[d] is taught by Kawakami for the reasons explained above for claim element 1[e].

217. Accordingly, Kawakami discloses and renders obvious claim 11[d].

218. Thus, Kawakami discloses and renders obvious all limitations of claim 11 and therefore renders claim 11 obvious.

### **3. Dependent Claims 5 and 15**

219. Claims 5 and 15, which depend from claims 1 and 11, respectively, additionally recite “wherein the transceiver includes at least one digital signal processor.”

220. A person having ordinary skill in the art would have understood that the mobile station and control station of Kawakami include a digital signal processor. A person having ordinary skill in the art would have understood that just like DSL transceivers require processing to perform Fourier Transform and Inverse Fourier Transform operations for DMT, Kawakami’s transceiver would require signal processing for wireless signals. This includes, at least, corresponding modulation and demodulation operations. Traditionally, these wireless transceivers implement this signal processing in digital signal processors (DSPs). *See, e.g.,* Hackett, Fig. 3 (depicting a transceiver in a mobile communications system that includes a high speed downlink packet access co-processor).

221. Accordingly, Kawakami discloses and renders obvious that the mobile station (transceiver) includes at least one digital signal processor.

222. Therefore, Kawakami anticipates claims 5 and 15.

#### **4. Dependent Claims 10 and 20**

223. Claims 10 and 20, which depend from claim 1 and 11, respectively, additionally recite “wherein the first type of packet is a low-PER (Packet Error Rate) packet and the second type of packet is a low-latency packet.”

224. The '055 patent describes “low-PER” packets as packets that “may have a very low packet error rate but can often tolerate higher delay.” '055 patent, 1:64-2:6. The '055 patent describes “low-latency” packets as packets that “may have very low latency requirements but can tolerate a higher packet error rate.” *Id.* The '055 patent discloses that an example of a low-PER packet is a video packet and an example of a low-latency packet is a voice or data packet. *Id.*, 2:4-6.

225. Kawakami discloses that an acknowledgement type packet (first type of packet) can tolerate some level of delay but cannot tolerate errors; whereas, an unacknowledgement type packet (second type of packet) can tolerate some degree of error but cannot tolerate delay. Kawakami, ¶[0037]. Kawakami discloses that an example of an acknowledgement type packet is a data packet and an example of an unacknowledgement type packet is a voice packet. *Id.*

226. Accordingly, Kawakami discloses and renders obvious claims 10 and 20.



**C. Ground 2: Claims 1, 4, 5, 7, 9, 10, 11, 14, 15, 17, 19, and 20 are unpatentable as obvious under 35 U.S.C. §103(a) by Reynders (Ex. 1005)**

227. It is my opinion that claims 1, 4, 5, 7, 9, 10, 11, 14, 15, 17, 19, and 20 of the '055 patent are unpatentable because each of the claims would have been obvious to a person having ordinary skill in the art in view of Reynders (Ex. 1005).

**1. Independent Claim 1**

**a. “A method of packet retransmission, in a transceiver, comprising:” (Claim 1[pre])**

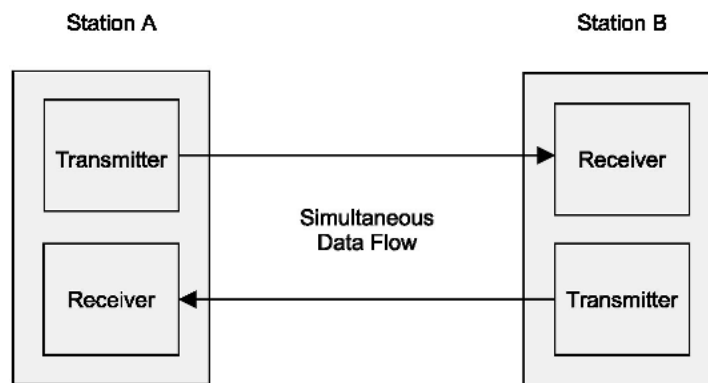
228. In my opinion, Reynders discloses and renders obvious “[a] method of packet retransmission, in a transceiver.”

229. A transceiver has been construed to be a “communications device capable of transmitting and receiving data wherein the transmitter portion and receiver portion share at least some common circuitry.” Claim Construction Order, 2.

230. Reynders discloses that many devices can transmit and receive data over the Internet (including TCP/IP data)—for instance, stations with full-duplex channels, computers, file-servers, terminals, workstations, routers, point-to-point protocol servers, modems, or integrated access servers. Reynders, 9 (stations with full-duplex channels), 15-16 (computers, file-servers, terminals, and workstations), 199 (routers, point-to-point protocol servers, modems, and integrated access

servers).

231. For example, Reynders depicts full-duplex transmission in Figure 1.11, which shows Station A and Station B each including a transmitter portion and a receiver portion:



Reynders, Fig. 1.11 (“Full-duplex transmission”).

232. A person having ordinary skill in the art would have understood that the stations with full-duplex channels, computers, file-servers, terminals, workstations, routers, point-to-point protocol servers, modems, or integrated access servers disclosed in Reynders all share common circuitry across the whole device, including their transmitting and receiving portions. As an example, a computer, workstation or server must send and receive data. While there will be some circuitry unique to the receiver or the transmitter, much of the circuitry will be shared between both functions, forming a transceiver. As an example, clock circuitry, power supplies, and other similar circuitry will be shared. The devices

described in Reynders are capable of transmitting and receiving information and, in general, will have some components shared between the two functions, meeting the Court's construction of a transceiver.

233. In particular, a person having ordinary skill in the art would have understood a modem to be a "transceiver" under the Court's construction. The term "modem" stands for modulator/demodulator. The modulator is used by the transmitter to modulate data onto a transmission media while a demodulator is used by the receiver to demodulate information contained on a transmission media, extracting the original information. A person having ordinary skill in the art would have recognized that the modem thus contains both transmitter and receiver functions, as well as other support functions, thus constituting a modem. A person having ordinary skill in the art would further understand that the transmitting and receiving portions of a modem would share some circuitry. While there will be some circuitry unique to the receiver or the transmitter, much of the circuitry will be shared between both functions, forming a transceiver. As an example, clock circuitry, power supplies, and other similar circuitry will be shared.

234. Reynders discloses a method of packet retransmission, including through the use of the TCP protocol, which can be performed on any of the devices identified in Reynders. *See, e.g.*, Reynders, 123 (with TCP, it is possible to

“arrange re-transmission in the case of lost packets”); *id.*, 125-127 (describing mechanism).

235. To the extent that Reynders’s disclosures are found to not explicitly include the use of a transceiver, a person having ordinary skill in the art would have found it obvious to use the methods of Reynders in a system that shared common circuitry between its data transmitting and receiving components. For example, Reynders discloses that the TCP/IP protocol suite is commonly used in combination with Ethernet systems. *See, e.g.*, Reynders, 75-76 (the “network interface layer” and “Internet layer” used with TCP/IP protocol suite are compatible with the use of Ethernet); *id.*, 126 (disclosing use of TCP with Ethernet); *id.*, 92-93 (discussing packet size for IP packets “transported over an Ethernet network”). Reynders further discloses that standard Ethernet transceivers could include common circuitry between their data transmitting and receiving components. *See, e.g., id.*, 64 (disclosing “100Base-T2 system” which can achieve “simultaneous[] transmitting and receiving” “by using digital signal processing (DSP) techniques”), *id.*, 70 (depicting “1000BaseT for category 5 UTP” which uses “digital signal processors” and depicting transmission and receipt of data).

236. Additionally, it would have been obvious to use the methods of Reynders with DSL systems, which were known to include transceivers. Reynders

does not explicitly refer to DSL systems, referring instead to examples of Internet access methods such as dial-up modem, ISDN connections, and leased lines.

Reynders, 199. However, it was common knowledge as of the priority date that DSL systems had advantages over these previous access methods, and DSL systems were rapidly being adopted by Internet subscribers around the world. *See* Halapoto, 222, 225; Sutherland, 4/1. It would have been obvious to a person having ordinary skill in the art to use the TCP/IP protocol suite in combination with any standard method of Internet access, including DSL, and would have been particularly obvious to use DSL because of its increasing popularity and advantages over prior systems. It was common knowledge in the art that DSL systems included transceivers—indeed, there were multiple published standards for the functionality of those transceivers. *See, e.g.*, G.992.1; G.992.3; G.993.1.

237. Accordingly, to the extent it is limiting, Reynders discloses and renders obvious claim 1[pre].

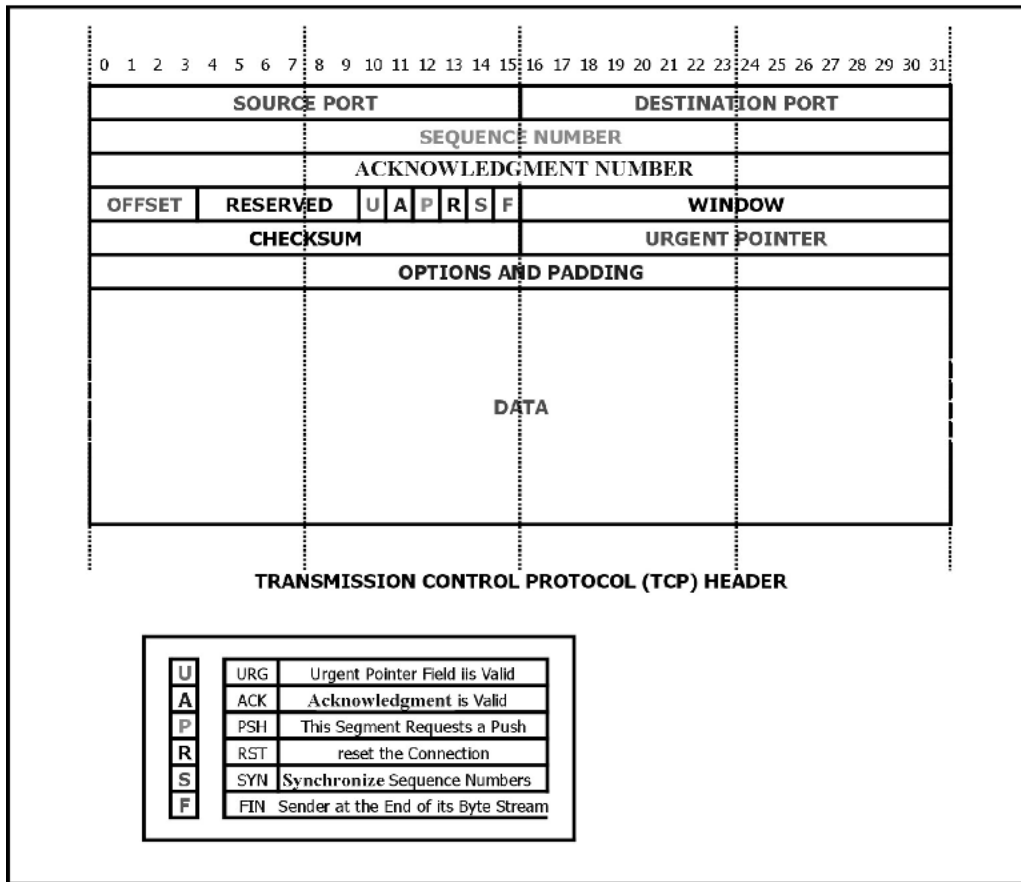
**b. “transmitting, by the transceiver, a first type of packet;” (Claim 1[a])**

238. Reynders discloses and renders obvious transmitting, by a modem (transceiver), a TCP/IP packet (first type of packet).

239. Reynders discloses two “relevant protocols” for the “host-to-host communications layer (also referred to as the service layer, or as the transport layer

in terms of the OSI model)”: TCP and UDP. Reynders, 122. Reynders discloses that each of these protocols has a different header (*compare id.*, 129 *with id.*, 131), resulting in two different packet types: TCP versus UDP. Both types of packets can be used with the foundational IP protocol, resulting in what I will refer to herein as TCP/IP or UDP/IP packets. Reynders, 76-77 (explaining that the “dominant protocol” in the internet layer is “IP (as in TCP/IP, namely the Internet protocol” and that the host-to-host layer has “two protocols associated with it,” UDP and TCP); *id.*, 77 (showing that the TCP or UDP protocols “reside[] above IP in the protocol stack”). Accordingly, Reynders discloses a “first type of packet”—namely, TCP/IP packets—and a “second type of packet”—namely, UDP/IP packets.

240. Both TCP/IP packets and UDP/IP packets are “packets” according to the claim construction I have applied for “packet,” i.e. “a grouping of bytes.” As shown in the diagrams of the TCP, UDP and IP packets copied from the IETF RFCs, above, each row of the diagram represents four bytes or 32 bits of information. For example, the diagram of a TCP/IP packet shown below, shows the bits 0-31 broken down into four bytes.



*Id.*, Fig. 7.5 (“TCP frame format”). There are several rows in the diagrams, indicating that several bytes comprise the packets, thus meeting the Courts construction of “packet.”

241. Reynders discloses that TCP/IP and TCP/UDP packets are transmitted by a transceiver. Reynders discloses the use of TCP/IP packets and TCP/UDP packets for transmissions over the Internet, including using a modem. *Id.*, 74 (“TCP/IP has become the *de facto* standard world-wide for industrial and telecommunications applications,” including because “the Internet was designed

around it in the first place” and “without it, no Internet access is possible”); *id.* 199 (discussing use of modems). As discussed above, a person having ordinary skill in the art would have understood that modems are transceivers. *See supra* §VI.C.1.a. Additionally, TCP inherently requires that the transmitting device be capable of sending and receiving data, due to its use of positive acknowledgement with retransmission. *See, e.g.*, Reynders, 125-126. Accordingly, Reynders discloses and renders obvious claim 1[a].

**c. “transmitting, by the transceiver, a second type of packet” (Claim 1[b])**

242. Reynders discloses transmitting a second type of packet.

243. As discussed with respect to Claim 1[a], Reynders discloses transmitting two types of packets: TCP/IP and UDP/IP. UDP/IP packets are a “second type of packet” according to claim 1[b].

244. Accordingly, Reynders discloses and renders obvious claim 1[b].

**d. “wherein the first type of packet is stored in a retransmission buffer after transmission and the second type of packet is not stored in a retransmission buffer after transmission” (Claim 1[c])**

245. Reynders discloses that the first type of packet is stored in a retransmission buffer and the second type is not.

246. Reynders discloses that the first type of packet—TCP/IP packets—



are designed to “arrange re-transmission in the case of lost packets.” *Id.*, 123. If an acknowledgement of successful transmission is not received within a given time, the transmitting system will retransmit “another copy of the message,” a technique known as “positive acknowledgement with retransmission.” *Id.*, 125.

247. A person having ordinary skill in the art would have understood that positive acknowledgement with retransmission inherently involves storing TCP/IP packets in a “retransmission buffer,” which is the term of art for temporarily storing the packets on the system in case they need to be retransmitted. *See, e.g.*, Park, 100 (noting that “[s]tandard TCP process” has a “retransmission buffer”); Smith, 194 (in TCP, “[d]ata that is transmitted is kept on a retransmission buffer until it has been acknowledged”); RFC 793, 10 (“When the TCP transmits a segment containing data, it puts a copy on a retransmission queue,” i.e. a retransmission buffer). A person having ordinary skill in the art would recognize that it is inherently necessary to use a retransmission buffer for retransmission – information that has been transmitted and may need to be re-transmitted must be stored somewhere or it will not be available for re-transmission when requested. A memory storage device is traditionally referred to as a buffer or storage buffer and one intended for use in retransmission is commonly referred to as a retransmission buffer.

248. Reynders therefore inherently discloses that the first type of packets—TCP/IP packets—are “stored in a retransmission buffer after transmission.”

249. Reynders discloses that the second type of packets—UDP/IP packets—are not retransmitted, according to the UDP protocol. Reynders, 131 (“Sending a UDP datagram [e.g., a UDP/IP packet] involves very little overhead in that there [is]... no retransmission of packets.”). A person having ordinary skill in the art would have understood that UDP/IP packets are therefore not stored in a “retransmission buffer,” because no such buffer is disclosed or would be necessary in the absence of retransmission. It would be obvious to a person having ordinary skill in the art that, since memory resources in a computing system are always at a premium, they should not be wasted. Thus, if a UDP packet will never be retransmitted, retaining a storage buffer would be inefficient, thus it would be obvious to not provide one. Reynders therefore inherently discloses that the second type of packets—UDP/IP packets—are “not stored in a retransmission buffer after transmission.” To the extent that Reynders’s disclosures are found to not explicitly disclose the fact that the first type of packet (TCP/IP) is stored in a retransmission buffer, a person having ordinary skill in the art would have found it obvious based on the general knowledge in the art. *See, e.g.,* Park, 100 (noting that “[s]tandard

TCP process” has a “retransmission buffer”); Smith, 194 (in TCP, “[d]ata that is transmitted is kept on a retransmission buffer until it has been acknowledged”); RFC 793, 10 (“When the TCP transmits a segment containing data, it puts a copy on a retransmission queue,” i.e. a retransmission buffer).

250. To the extent that Reynders’s disclosures do not explicitly include the fact that the second type of packet (UDP/IP) is not stored in a retransmission buffer, a person having ordinary skill in the art would have found it obvious based on the general knowledge in the art. It was known that UDP/IP packets did not require retransmission. Reynders, 131 (“Sending a UDP datagram [e.g., a UDP/IP packet] involves very little overhead in that there [is]... no retransmission of packets.”); *see generally* RFC 768 (no discussion of any requirement for retransmission of UDP packets). It therefore would have been obvious not to store UDP/IP packets in a retransmission buffer, as there would be no need to do so.

251. Therefore, Reynders discloses and renders obvious claim 1[c].

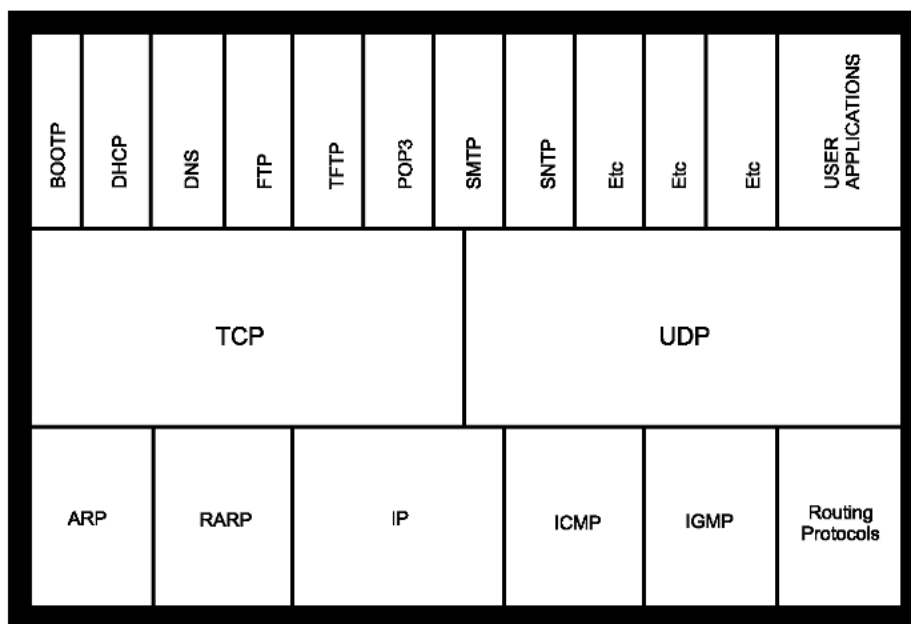
**e. “wherein the first and second types of packet comprise a header field that indicates whether a transmitted packet is a first type of packet or a second type of packet” (Claim 1[d])**

252. Reynders discloses that the first and second types of packets include a header field that indicates the type of packet.

253. Reynders discloses that both the first type of packets (TCP/IP) and

the second type of packets (UDP/IP) contain an IP header that indicates whether the packet is a TCP/IP packet or a UDP/IP packet.

254. Reynders discloses that an IP header is “appended to the data that IP accepts from higher-level protocols.” Reynders, 89. Figure 5.2 of Reynders illustrates that the TCP and UDP protocols are above IP protocol in the protocol stack.



*Id.*, Fig. 5.2 (“The TCP/IP protocol suite”). Reynders therefore discloses that both TCP/IP and UDP/IP packets will contain IP headers in addition to their TCP or UDP headers.

255. Reynders discloses that IP headers contain a header field that indicates whether a transmitted packet is a TCP/IP packet or a UDP/IP packet. Specifically, Reynders discloses that the IPv4 header contains a “Protocol” field

that “indicates the next (higher) level protocol used in the data portion of the Internet diagram, in other words the protocol that resides above IP in the protocol stack and which has passed the datagram on to IP.” *Id.*, 92. A person having ordinary skill in the art would have understood this to mean that the “Protocol” field indicates whether a packet is a TCP/IP or a UDP/IP packet, as those protocols reside above IP in the protocol stack. *See id.*, 77 (depicting protocol stack). Reynders discusses how the IPv6 IP protocol, which may be implemented in the future, contains a “Next Header” field which “identifies the type of header immediately following the IPv6 header,” which could include TCP or UDP headers. *Id.*, 96.

256. Reynders therefore discloses that the “first and second types of packet”—TCP/IP and UDP/IP—both “comprise a header field that indicates whether a transmitted packet is a first type of packet or a second type of packet,” i.e. the “Protocol” field of a IPv4 header or the “Next Header” field of an IPv6 header.

257. Accordingly, Reynders discloses and renders obvious claim 1[d].

- f. **“wherein the header field of the first type of packet comprises a sequence identifier (SID) that is incremented after the first type of packet is transmitted and the header field of the second type of packet does not comprise the SID of the first type of packet.” (Claim 1[e])**

258. Reynders discloses that the header field of the first type of packet includes a sequence identifier (SID) that is incremented after the first type of packet is transmitted and the header field of the second type of packet does not include such an SID.

259. Reynders discloses that the header field of the first type of packet—TCP/IP—includes a TCP header with the “Sequence Number” field, which a person having ordinary skill in the art would have understood to be a “sequence identifier” according to claim 1[e]. *Id.*, 129. Reynders discloses that the sequence number of a TCP header is incremented after a TCP/IP packet is transmitted. *Id.*, 124 (“A fundamental notion in the TCP design is that every BYTE of data sent over the TCP connection has a unique 32-bit sequence number... for each subsequent byte that number is simply incremented by the receiver in order to keep track of the bytes.”).

260. Reynders discloses that the header field of the second type of packet—UDP/IP—does not include the “Sequence Number” field of a TCP/IP packet. Specifically, Reynders discloses that the UDP header of a UDP/IP packet does not contain a sequence number field. *Id.*, 131.

261. Accordingly, Reynders discloses and renders obvious claimed 1[e].

262. Thus, Reynders discloses all limitations of claim 1 and renders claim

1 obvious.

## **2. Independent Claim 11**

263. Claim 11 is similar to claim 1, except that whereas claim 1 is directed to a method of packet retransmission in a transceiver, claim 11 is directed to a transceiver, which is operable to perform the method recited in claim 1.

264. As explained above, Reynders renders claim 1 obvious. As explained further below, Reynders renders claim 11 obvious as well.

### **a. “A transceiver” (Claim 11 [pre])**

265. As explained above (§VI.C.1.a, *supra*), Reynders discloses and renders obvious a transceiver.

266. Accordingly, to the extent it is limiting, Reynders discloses and renders obvious claim 11[pre].

### **b. “operable to transmit a first type of packet and a second type of packet” (Claim 11[a])**

267. As explained above (§§VI.C.1.b, VI.C.1c, *supra*), Reynders discloses that the transceiver is operable to transmit a first type of packet and a second type of packet.

268. Therefore, Reynders discloses and renders obvious claim 11[a].

### **c. “wherein the first type of packet is stored in a retransmission buffer after transmission and the second type of packet is not stored in a retransmission buffer after transmission” (Claim 11[b])**

269. Claim element 11[b] recites the same claim element set forth in claim 1[c]. Therefore, claim element 11[b] is taught by Reynders for the reasons explained above for claim element 1[c].

270. Accordingly, Reynders discloses and renders obvious claim 11[b].

- d. “wherein the first and second types of packet comprise a header field that indicates whether a transmitted packet is a first type of packet or a second type of packet” (Claim 11[c])**

271. Claim element 11[c] recites the same claim element set forth in claim 1[d]. Therefore, claim element 11[c] is taught by Reynders for the reasons explained above for claim element 1[d].

272. Therefore, Reynders discloses and renders obvious claim 11[c].

- e. “wherein the header field of the first type of packet comprises a sequence identifier (SID) that is incremented after the first type of packet is transmitted and the header field of the second type of packet does not comprise the SID of the first type of packet” (Claim 11[d])**

273. Claim element 11[d] recites the same claim element set forth in claim 1[e]. Therefore, claim element 11[d] is taught by Reynders for the reasons explained above for claim element 1[e].

274. Accordingly, Reynders discloses and renders obvious claim 11[d].

275. Thus, Reynders discloses all limitations of claim 11 and therefore



renders claim 11 obvious.

### **3. Dependent Claims 4 and 14**

276. Claim 4, which depends from claim 1, adds the limitation “wherein the method is performed in a customer premises modem that is operable to transport video.” Claim 14, which depends from claim 11, adds the limitation “wherein the transceiver is located in a customer premises modem that is operable to transport video.”

277. Reynders discloses that “single user[s]” and “[l]arger organizations” can connect to the Internet using modems. *Id.*, 199-200. A person having ordinary skill in the art would have understood from this disclosure that these modems would be located at the premises of the user or organization, and would therefore be “customer premises modems” according to claim 4 or claim 14.

278. Reynders discloses that “the TCP/IP protocol suite” includes both TCP/IP and TCP/UDP packets (*id.*, 75-77), and that this protocol suite is the basis for all Internet communications—“the Internet was designed around it in the first place, and... without it, no Internet access is possible.” *Id.*, 74. Reynders therefore inherently discloses that its methods can be performed in a “customer premises modem.”

279. Reynders discloses that Internet-capable devices, which would

include customer premises modems, are intrinsically capable of transporting video data. *See, e.g.*, Reynders, 204 (“It is therefore only logical that the Internet will... be used for telecommunications (voice, fax, video etc) on an ever-increasing scale”); *id.*, 204 (noting “video transmissions”, “voice/video/fax traffic,” and “transmitting voice and video” over the Internet); *Id.*, 205 (“Once voice or video has been digitized into packets it is no different from any other data!”); *id.*, 131 (a “particularly good application” for UDP is “streaming video”).

280. Accordingly, Reynders discloses the limitations “wherein the method is performed in a customer premises modem that is operable to transport video” and “wherein the transceiver is located in a customer premises modem that is operable to transport video.”

281. To the extent that Reynders’s disclosures are found to not explicitly include the use of “a customer premises modem that is operable to transport video,” a person having ordinary skill in the art would have found it obvious based on the same disclosures above: that modems could be used to connect to the Internet, that modems could be located in the premises of individual consumers or businesses, that the Internet relied on the TCP/IP protocol suite, and that the Internet could be used to transport video the same way as any other data. *See id.*

282. Accordingly, it would have been obvious to a person having ordinary

skill in the art to include the use of “a customer premises modem that is operable to transport video” with the TCP/IP and TCP/UDP packet transmission taught by Reynders.

283. Therefore, Reynders renders claims 4 and 14 obvious.

#### **4. Dependent Claims 5 and 15**

284. Claims 5 and 15, which depend from claims 1 and 1, respectively, additionally recite “wherein the transceiver includes at least one digital signal processor.”

285. Reynders discloses that “[m]ost networks use digital signaling.” *Id.*, 28. Reynders further discloses the use of digital signal processing and digital signal processors in Ethernet transceivers. *See, e.g., id.*, 64 (disclosing “100Base-T2 system” which can achieve “simultaneous[] transmitting and receiving” “by using digital signal processing (DSP) techniques”), *id.*, 70 (depicting “1000BaseT for category 5 UTP” which uses “digital signal processors” and depicting transmission and receipt of data). Reynders discloses that the TCP/IP protocol suite is commonly used in combination with Ethernet systems. *See, e.g., Reynders*, 75-76 (the “network interface layer” and “Internet layer” used with TCP/IP protocol suite are compatible with the use of Ethernet); *id.*, 126 (disclosing use of TCP with Ethernet); *id.*, 92-93 (discussing packet size for IP packets “transported over an

Ethernet network”). Reynders therefore discloses transceivers “include[ing] at least one digital signal processor.”

286. To the extent that Reynders’s disclosures are found to not explicitly include the use of a transceiver “includ[ing] at least one digital signal processor,” a person having ordinary skill in the art would have found it obvious. A person having ordinary skill in the art as of the priority date of the ’055 patent would have understood that bit processing in ADSL transceivers was commonly performed by digital signal processors. For example, a leading text in the field of ADSL at the time, *ADSL Standards, Implementation, and Architecture*, repeatedly mentions microprocessors. *See, e.g.,* Summers, C. K., *ADSL Standards, Implementation, and Architecture*, CRC Press (1999) (“Summers”) (Ex. 1026), 74 (emphasis added) (“The interface chip is the chip at the heart of telecommunications equipment. The interface chip deals with the physical medium in the manner necessary to perform the physical layer protocol. In the case of ADSL, this means performing the functions of three major functional blocks: Digital Interface (DI), *Digital Signal Processing (DSP)*, and Analog Interfaces (AI).”); *Id.*, 84 (emphasis added) (“[A] *microprocessor* needs to access information within an interface chip. The memory map indicates that all I/O performed between 0x4000 to 0x43RR (a range of 1024 identifiers) will be routed between the requesting device and the interface chip.

The ‘address decoding logic’ indicates that when this address is written onto the address bus, a sequence of instructions will commence. . . . The net effect will be that a write of data to address 0x4204 will go to the interface chip and that, because of the specific location within the address range, some type of behavior is expected as a result of the write.”); *Id.*, 87 (“A Low-Level Driver (LLD) acts as the software interface between a semiconductor device and the controlling software.... The LLD must be able to interpret primitives from, and send primitives to, the software module (or modules) with which it is associated.”); *Id.*, 94 (“Our discussion on LLDs indicated that that ADSL chipset interface was needed to create an interface between the software (running on a controlling general-purpose *microprocessor*) and the hardware.”).

287. Moreover, and as discussed elsewhere herein, in my experience, every DSL transceiver includes some kind of processor (e.g., a digital signal processor, microprocessor, etc.). It was commonplace by April 12, 2006 for ADSL transceivers to include a digital signal processor. *See, e.g., See, e.g., Texas Instruments TNETD2000C Product Bulletin*, (“TNETD2000C Product Bulletin”) (Ex. 1027), 1 (“At the heart of the TNETD2000C’s architecture is the power of ‘C6x DSP technology.”).

288. Accordingly, it would have been obvious to a person having ordinary

skill in the art to include at least one digital signal processor in the transceivers taught by Reynders.

289. Therefore, Reynders renders claims 5 and 15 obvious.

## **5. Dependent Claims 7 and 17**

290. Claims 7 and 17, which depend from claims 1 and 11, respectively, additionally recite “wherein the first type of packet comprises one or more PTM-TC (Packet Transfer Mode-Transmission Convergence) codewords.”

291. As discussed above with respect to claim 1, it would have been obvious to use the methods of Reynders in DSL systems. *See supra* §VI.C.1.a.

292. As explained above, various DSL standards as of the priority date required the use of PTM-TC codewords. *See* G.993.1, 143 (“In the transmit direction... [t]he corresponding TPS-TC (PTM-TC) receives the packet from the  $\gamma$  interface, encapsulates it into a special frame (PTM-TC frame) and maps into the PMS-TC frame (transmission frame) for transmission over the VDSL link”); G.992.3, 294 (identifying requirement of “Packet transmission convergence function (PTM-TC)”).

293. Accordingly, a person having ordinary skill in the art would have found it obvious to include PTM-TC codewords in TCP/IP protocol packets transmitted through a DSL system.

294. Therefore, Reynders renders claims 7 and 17 obvious.

## **6. Dependent Claims 9 and 19**

295. Claims 9 and 19, which depend from claims 1 and 11, respectively, additionally recite “wherein the first type of packet comprises one or more Reed Solomon codewords.”

296. As discussed above with respect to claim 1, it would have been obvious to use the TCP/IP protocol suite disclosed in Reynders with DSL systems. *See supra* §VI.C.1.a. As discussed above, many standards specify the use of Reed-Solomon coding in DSL systems. *See supra* §IV.A.6.a. A person having ordinary skill in the art would therefore find it obvious to include Reed-Solomon codewords in TCP/IP protocol packets transmitted through a DSL system.

297. A person having ordinary skill in the art would additionally have found the use of Reed-Solomon codewords with Reynders’s technology to be obvious, and would have been motivated to include them, because Reed-Solomon codes were very well known, having been developed in 1960, and were very popular for many applications given their power, ease of implementation, and ready availability of many implementation in hardware and software.

298. A person having ordinary skill in the art would therefore have found it obvious to include Reed-Solomon codewords in TCP/IP packets transmitted

through a DSL system.

299. Thus, Reynders renders claims 9 and 19 obvious.

## **7. Dependent Claims 10 and 20**

300. Claims 10 and 20, which depend from claim 1 and 11, respectively, additionally recite “wherein the first type of packet is a low-PER (Packet Error Rate) packet and the second type of packet is a low-latency packet.”

301. Reynders discloses that the first type of packet—TCP/IP—is a low-PER packet. Specifically, Reynders states that TCP/IP is a protocol that “offers vastly improved... error control” and “provides a very reliable method of transferring data,” in contrast to UDP which is an “unreliable” protocol. *Id.*, 76-77.

302. Reynders discloses that the second type of packet—UDP/IP—is a low-latency packet. Specifically, Reynders discloses that UDP “involves very little overhead” and that the protocol is “quick, and streamlined functionally,” making it a good choice for “real-time data” including “streaming video and streaming audio.” *Id.*, 131. In contrast, Reynders notes that TCP “involves significant overhead in terms of processing time.” *Id.* A person having ordinary skill in the art would have understood from these disclosures that UDP/IP is a low-latency packet.

303. Therefore, Reynders renders claims 10 and 20 obvious.



**D. Ground 3: Claims 1, 4, 5, 7, 9, 10, 11, 14, 15, 17, 19, and 20 are unpatentable as obvious under 35 U.S.C. §103(a) over RFC 791 (Ex. 1006), RFC 793 (Ex. 1007), and RFC 768 (Ex. 1008).**

**1. Motivation to Combine**

304. In my opinion, a person having ordinary skill in the art would have been motivated to combine the teachings of RFC 791, RFC 793, and RFC 768 to arrive at the claimed invention of the '055 patent.

305. The Internet Engineering Task Force or IETF, formed in 1986, was originally sponsored by the U.S. Government to establish standards for the Internet. Since 1993, it has been a standards organization under the auspices of the Internet Society. Standards established by the IETF are in the form of Requests for Comment (RFCs). A person having ordinary skill in the art looking to understand the operation of the Internet or design systems based on the Internet would have understood that the RFCs promulgated by the IETF were the authoritative documents to drive their design and understanding. RFC 791, RFC 793, and RFC 768, in particular, are all closely interrelated documents that a person having ordinary skill in the art would have been motivated to consider in their entirety to understand how TCP/IP networks operate.

306. A person having ordinary skill in the art would have been familiar with RFC 791, RFC 793, and RFC 768 as foundational standards for the TCP/IP

protocol suite that is central to the operation of the Internet. *See, e.g.*, Reynders, 76-77 (identifying “Internet protocol” (i.e., RFC 791), RFC 793, and RFC 768 as foundational standards for TCP/IP protocol suite); *id.*, 74 (“One of the major reasons why TCP/IP has become the *de facto* standard world-wide... is the fact that the Internet was designed around it in the first place and that, without it, no Internet access is possible.”).

307. Additionally, Figure 1 of RFC 791, the foundational document of the Internet Protocol, depicts the relationship between IP and the protocols including TCP and UDP. RFC 791, 5. Moreover, RFC 791 includes definitions for TCP and UDP in its glossary. *Id.*, 43, 44. Thus, a person having ordinary skill in the art interested in implementing the Internet Protocol described by RFC 791 would naturally have sought out the protocols for the layer that IP communicates with, TCP and UDP. Therefore, a person having ordinary skill in the art would have looked to the foundational documents for those protocols, RFC 793 and RFC 768, respectively.

308. Therefore, a person having ordinary skill in the art would have been motivated to combine the protocol of the Internet layer (RFC 791) with the two protocols of the next layer in the protocol hierarchy, the Transmission Control Protocol (RFC 793) and the User Datagram Protocol (RFC 768).

## **2. Independent Claim 1**

### **a. “A method of packet retransmission, in a transceiver, comprising:” (Claim 1[pre])**

309. In my opinion, RFC 791, RFC 793, and RFC 768 render obvious “[a] method of packet retransmission, in a transceiver.”

310. A transceiver has been construed to be a “communications device capable of transmitting and receiving data wherein the transmitter portion and receiver portion share at least some common circuitry.” Claim Construction Order, 2.

311. It would have been obvious and necessary to use the TCP/IP protocol suite disclosed in RFC 791, RFC 793, and RFC 768 with transceivers. DSL transceivers routinely interface with computers, servers, workstations, and various consumer electronic devices. Rather than each individual system using different interface standards, it is customary to choose one or a small number of protocols to allow interoperability. TCP/IP is recognized as one of the most popular and widely used data communications protocols with millions or billions of devices supporting it. It is logical to use TCP/IP as the one of the most important protocols of choice for DSL transceivers.

312. For example, it would have been obvious to use the TCP/IP protocol suite disclosed in RFC 791, RFC 793, and RFC 768 of Reynders with DSL

systems, which were known to include transceivers. It was common knowledge as of the priority date that DSL systems had advantages over previous Internet access methods, and DSL systems were rapidly being adopted by Internet subscribers around the world. *See, e.g.*, Halapoto, 222, 225; Sutherland, 4/1. It would have been obvious to a person having ordinary skill in the art to use the TCP/IP protocol suite in combination with any standard method of Internet access, including DSL, and would have been particularly obvious to use DSL because of its increasing popularity and advantages over prior systems. It was common knowledge in the art that DSL systems included transceivers—indeed, there were multiple published standards for the functionality of those transceivers. *See, e.g.*, G.992.1; G.992.3; G.993.1.

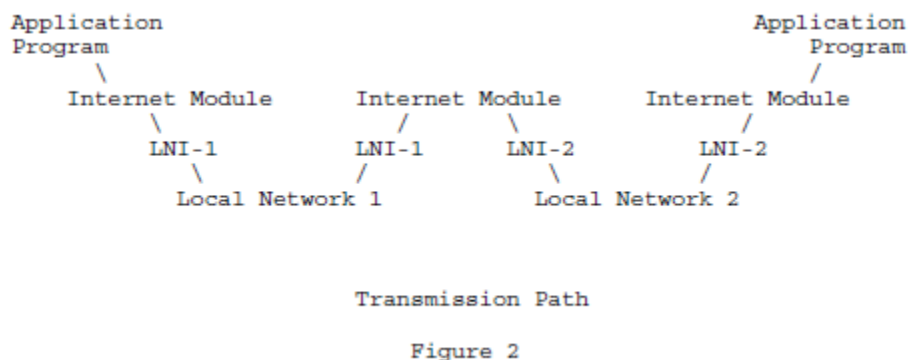
313. RFC 793, the foundational document for the TCP protocol, discloses a method of packet retransmission. Specifically, it discloses that “[w]hen the TCP transmits a segment containing data, it puts a copy on a retransmission queue and starts a timer; when the acknowledgment for that data is received, the segment is deleted from the queue. If the acknowledgment is not received before the timer runs out, the segment is retransmitted.” RFC 793, 9-10.

314. Accordingly, to the extent it is limiting, RFC 791, RFC 793, and RFC 768 render claim 1[pre] obvious.

**b. “transmitting, by the transceiver, a first type of packet;” (Claim 1[a])**

315. RFC 791, RFC 793, and RFC 768 disclose and render obvious transmitting a TCP/IP packet (first type of packet) by a transceiver.

316. RFC 791 is the foundational standard for the IP protocol, the entire purpose of which is the transmission of packets in a network. *See, e.g.*, RFC 791, 6:



*Id.*, Fig. 2.

317. RFC 791 discloses transmission of multiple types of packets. It discloses that the “Protocol” field in the IP header “indicates the next level protocol used in the data portion of the internet datagram,” citing to RFC 790 for a list of assigned numbers. RFC 791, 14. RFC 791 explains that these “next level protocols” are TCP and UDP. *Id.*, 5. RFC 790, “Assigned Numbers” (September 1981), confirms that the Protocol field may indicate that a packet is a TCP packet (decimal 6) or a UDP packet (decimal 17), along with other options. RFC 790, 6.

318. RFC 791 discloses that the final data packet will include headers from each layer of the protocol, and that TCP and UDP are in the layer above IP. RFC 791, 1, 5. RFC 791 therefore discloses and renders obvious transmitting at least a first type and a second type of packet: TCP/IP (containing a TCP header and a IP header), and UDP/IP (containing a UDP header and an IP header).

319. As explained above with respect to Reynders, both TCP/IP packets and UDP/IP packets are “packets” according to the claim construction I have applied for “packet,” i.e. “a grouping of bytes.” *See* §VI.C.b, *supra*.

320. Accordingly, RFC 791, RFC 793, and RFC 768 disclose and render obvious claim 1[a].

**c. “transmitting, by the transceiver, a second type of packet” (Claim 1[b])**

321. As discussed above with respect to claim 1[a], RFC 791, RFC 793, and RFC 768 disclose and render obvious transmitting a UDP/IP packet (second type of packet) in addition to a TCP/IP packet (first type of packet).

322. Accordingly, RFC 791, RFC 793, and RFC 768 disclose and render obvious claim 1[b].

**d. “wherein the first type of packet is stored in a retransmission buffer after transmission and the second type of packet is not stored in a retransmission buffer after transmission” (Claim 1[c])**

323. RFC 791, RFC 793, and RFC 768 disclose and render obvious that an acknowledgement type packet (first type of packet) is stored in a retransmission buffer after transmission and that an unacknowledgement type packet (second type of packet) is not stored in a retransmission buffer after transmission.

324. RFC 793, the foundational document for the TCP protocol, discloses a method of packet retransmission for the first type of packet (TCP/IP). Specifically, it discloses that “[w]hen the TCP transmits a segment containing data, it puts a copy on a retransmission queue and starts a timer; when the acknowledgment for that data is received, the segment is deleted from the queue. If the acknowledgment is not received before the timer runs out, the segment is retransmitted.” RFC 793, 9-10. A person having ordinary skill in the art would have understood a “retransmission queue” and a “retransmission buffer” to be synonyms.

325. RFC 768, the foundational document for the UDP protocol, discloses that the second type of packet (UDP/IP) is not stored in a retransmission buffer after transmission, because it is not retransmitted. RFC 768 says nothing about retransmission, and a person having ordinary skill in the art would have understood from that fact that retransmission of packets is not contemplated. *See generally* RFC 768. RFC 768 also notes that “delivery and duplicate protection are not

guaranteed,” confirming the lack of retransmission in UDP. *Id.*, 1. It was also generally understood in the art that UDP did not involve retransmission.

Anandakumar, ¶[0212]; Reynders, 131.

326. Therefore, RFC 791, RFC 793, and RFC 768 disclose and render obvious claim 1[c].

- e. **“wherein the first and second types of packet comprise a header field that indicates whether a transmitted packet is a first type of packet or a second type of packet” (Claim 1[d])**

327. RFC 791, RFC 793, and RFC 768 disclose and render obvious that a TCP/IP packet (first type of packet) and a UDP/IP packet (second type of packet) each include a header field that indicates the type of packet.

328. As discussed above, RFC 791 discloses that a TCP/IP packet and a UDP/IP packet each contain an IP header, whose “Protocol” field indicates whether the packet is a TCP/IP packet or a UDP/IP packet. *See* §VI.D.2.b, *supra*.

329. Accordingly, RFC 791, RFC 793, and RFC 768 disclose and render obvious claim 1[d].

- f. **“wherein the header field of the first type of packet comprises a sequence identifier (SID) that is incremented after the first type of packet is transmitted and the header field of the second type of packet does not comprise the SID of the first type of packet.” (Claim 1[e])**



330. RFC 791, RFC 793, and RFC 768 disclose and render obvious that the header field of a TCP/IP packet (first type of packet) includes a sequence identifier (SID) that is incremented after the TCP/IP packet is transmitted and that the header field of a UDP/IP packet (second type of packet) does not include such an SID.

331. RFC 793 discloses that a TCP header includes a “Sequence Number” field that is incremented each time a TCP packet is transmitted. RFC 793, 15 (depicting headers, including Sequence Number); *id.*, 83 (disclosing that the sequence number is “incremented for each octet of data or sequenced control transmitted” to establish “the next sequence number the local (sending) TCP will use on the connection.”).

332. RFC 768 discloses that UDP headers do not contain a sequence number. *Id.*, 1.

333. Accordingly, RFC 791, RFC 793, and RFC 768 disclose and render obvious claimed 1[e].

334. Thus, RFC 791, RFC 793, and RFC 768 render claim 1 obvious.

### **3. Independent Claim 11**

335. Claim 11 is similar to claim 1, except that whereas claim 1 is directed to a method of packet retransmission in a transceiver, claim 11 is directed to a

transceiver, which is operable to perform the method recited in claim 1.

336. As explained above, RFC 791, RFC 793, and RFC 768 render claim 1 obvious. As explained further below, RFC 791, RFC 793, and RFC 768 render claim 11 obvious as well.

**a. “A transceiver” (Claim 11 [pre])**

337. As explained above (§VI.D.2.a, *supra*), RFC 791, RFC 793, and RFC 768 disclose and render obvious a transceiver.

338. Accordingly, to the extent it is limiting, RFC 791, RFC 793, and RFC 768 disclose and render obvious claim 11[pre].

**b. “operable to transmit a first type of packet and a second type of packet” (Claim 11[a])**

339. As explained above (§§VI.D.2.b, VI.D.2.c, *supra*), RFC 791, RFC 793, and RFC 768 disclose and render obvious that the transceiver is operable to transmit a TCP/IP packet (first type of packet) and a UDP/IP packet (second type of packet).

340. Therefore, RFC 791, RFC 793, and RFC 768 disclose and render obvious claim 11[a].

**c. “wherein the first type of packet is stored in a retransmission buffer after transmission and the second type of packet is not stored in a retransmission buffer after transmission” (Claim 11[b])**

341. Claim element 11[b] recites the same claim element set forth in claim

1[c]. Therefore, claim element 11[b] is taught by RFC 791, RFC 793, and RFC 768 for the reasons explained above for claim element 1[c].

342. Accordingly, RFC 791, RFC 793, and RFC 768 disclose and render obvious claim 11[b].

- d. “wherein the first and second types of packet comprise a header field that indicates whether a transmitted packet is a first type of packet or a second type of packet” (Claim 11[c])**

343. Claim element 11[c] recites the same claim element set forth in claim 1[d]. Therefore, claim element 11[c] is taught by RFC 791, RFC 793, and RFC 768 for the reasons explained above for claim element 1[d].

344. Therefore, RFC 791, RFC 793, and RFC 768 disclose and render obvious claim 11[c].

- e. “wherein the header field of the first type of packet comprises a sequence identifier (SID) that is incremented after the first type of packet is transmitted and the header field of the second type of packet does not comprise the SID of the first type of packet” (Claim 11[d])**

345. Claim element 11[d] recites the same claim element set forth in claim 1[e]. Therefore, claim element 11[d] is taught by RFC 791, RFC 793, and RFC 768 for the reasons explained above for claim element 1[e].

346. Accordingly, RFC 791, RFC 793, and RFC 768 disclose and render

obvious claim 11[d].

347. Thus, RFC 791, RFC 793, and RFC 768 render claim 11 obvious.

#### **4. Dependent Claims 4 and 14**

348. Claim 4, which depends from claim 1, adds the limitation “wherein the method is performed in a customer premises modem that is operable to transport video.” Claim 14, which depends from claim 11, adds the limitation “wherein the transceiver is located in a customer premises modem that is operable to transport video.”

349. A person having ordinary skill in the art would have found it obvious to transmit TCP/IP and UDP/IP packets as described in RFC 791, RFC 793, and RFC 768 in a customer premises modem operable to transport video. As discussed above with respect to Reynders, which reflects the common knowledge in the art on these points, it was known as the priority date that modems could be used to connect to the Internet, that modems could be located in the premises of individual consumers or businesses, that the Internet relied on the TCP/IP protocol suite, and that the Internet could be used to transport video the same way as any other data.

*See supra* §VI.C.3.

350. Accordingly, it would have been obvious to a person having ordinary skill in the art to transmit TCP/IP and UDP/IP packets as described in RFC 791,

RFC 793, and RFC 768 in a customer premises modem operable to transport video

351. Therefore, RFC 791, RFC 793, and RFC 768 render claims 4 and 14 obvious.

## **5. Dependent Claims 5 and 15**

352. Claims 5 and 15, which depend from claims 1 and 1, respectively, additionally recite “wherein the transceiver includes at least one digital signal processor.”

353. A person having ordinary skill in the art would have found it obvious to include a digital signal processor in a transceiver transmitting TCP/IP and UDP/IP packets as described in RFC 791, RFC 793, and RFC 768.

354. A person having ordinary skill in the art as of the priority date of the ’055 patent would have understood that bit processing in ADSL transceivers was commonly performed by digital signal processors. For example, a leading text in the field of ADSL at the time, *ADSL Standards, Implementation, and Architecture*, repeatedly mentions microprocessors. *See, e.g., Summers, 74* (emphasis added) (“The interface chip is the chip at the heart of telecommunications equipment. The interface chip deals with the physical medium in the manner necessary to perform the physical layer protocol. In the case of ADSL, this means performing the functions of three major functional blocks: Digital Interface (DI), *Digital Signal*

*Processing (DSP)*, and Analog Interfaces (AI).”); *Id.*, 84 (emphasis added) (“[A] *microprocessor* needs to access information within an interface chip. The memory map indicates that all I/O performed between 0x4000 to 0x43RR (a range of 1024 identifiers) will be routed between the requesting device and the interface chip. The ‘address decoding logic’ indicates that when this address is written onto the address bus, a sequence of instructions will commence. . . . The net effect will be that a write of data to address 0x4204 will go to the interface chip and that, because of the specific location within the address range, some type of behavior is expected as a result of the write.”); *Id.*, 87 (“A Low-Level Driver (LLD) acts as the software interface between a semiconductor device and the controlling software.... The LLD must be able to interpret primitives from, and send primitives to, the software module (or modules) with which it is associated.”); *Id.*, 94 (“Our discussion on LLDs indicated that that ADSL chipset interface was needed to create an interface between the software (running on a controlling general-purpose *microprocessor*) and the hardware.”).

355. Moreover, and as discussed elsewhere herein, in my experience, every DSL transceiver includes some kind of processor (e.g., a digital signal processor, microprocessor, etc.). It was commonplace by April 12, 2006 for ADSL transceivers to include a digital signal processor. *See, e.g.*, TNETD200C Product

Bulletin, 1.

356. Accordingly, it would have been obvious to a person having ordinary skill in the art to include at least one digital signal processor in a transceiver transmitting TCP/IP and UDP/IP packets as described in RFC 791, RFC 793, and RFC 768.

357. Therefore, RFC 791, RFC 793, and RFC 768 render claims 5 and 15 obvious.

## **6. Dependent Claims 7 and 17**

358. Claims 7 and 17, which depend from claims 1 and 11, respectively, additionally recite “wherein the first type of packet comprises one or more PTM-TC (Packet Transfer Mode-Transmission Convergence) codewords.”

359. As discussed above with respect to claim 1, it would have been obvious to transmit TCP/IP and UDP/IP packets as described in RFC 791, RFC 793, and RFC 768 in DSL systems. *See supra* §VI.D.2.a.

360. As explained above, various DSL standards as of the priority date required the use of PTM-TC codewords. *See* G.993.1, 143 (“In the transmit direction... [t]he corresponding TPS-TC (PTM-TC) receives the packet from the  $\gamma$  interface, encapsulates it into a special frame (PTM-TC frame) and maps into the PMS-TC frame (transmission frame) for transmission over the VDSL link”);

G.992.3, 294 (identifying requirement of “Packet transmission convergence function (PTM-TC)”).

361. A person having ordinary skill in the art would therefore have found it obvious to include PTM-TC codewords in TCP/IP packets transmitted through a DSL system.

362. Accordingly, RFC 791, RFC 793, and RFC 768 render claims 7 and 17 obvious.

## **7. Dependent Claims 9 and 19**

363. Claims 9 and 19, which depend from claims 1 and 11, respectively, additionally recite “wherein the first type of packet comprises one or more Reed Solomon codewords.”

364. As discussed above with respect to claim 1, it would have been obvious to use the TCP/IP protocol suite disclosed in RFC 791, RFC 793, and RFC 768 with DSL systems. *See supra* §VI.D.2.a. As discussed above, Reed-Solomon coding is standardly used in DSL systems. *See supra* §IV.A.6.a. A person having ordinary skill in the art would therefore find it obvious to include Reed-Solomon codewords in TCP/IP protocol packets transmitted through a DSL system.

365. A person having ordinary skill in the art would additionally have found the use of Reed-Solomon codewords with the TCP/IP protocol suite to be



obvious, and would have been motivated to include them, because Reed-Solomon codes were very well known, having been developed in 1960, and were very popular for many applications given their power, ease of implementation, and ready availability of many implementation in hardware and software.

366. A person having ordinary skill in the art would therefore have found it obvious to include Reed-Solomon codewords in TCP/IP packets transmitted through a DSL system.

367. Therefore, claims 9 and 19 are obvious over RFC 791, RFC 793, and RFC 768.

## **8. Dependent Claims 10 and 20**

368. Claims 10 and 20, which depend from claim 1 and 11, respectively, additionally recite “wherein the first type of packet is a low-PER (Packet Error Rate) packet and the second type of packet is a low-latency packet.”

369. RFC 793 discloses that the first type of packet—TCP/IP—is a low-PER packet. Specifically, RFC 793 discloses that TCP is “a highly reliable host-to-host protocol” (RFC 793, 4), and that “[t]ransmission is made reliable via the use of sequence numbers and acknowledgments.” *Id.*, 9-10; *see also* Anandakumar [0013]; Jorgensen [0385]; Reynders, 123.

370. RFC 768 discloses that the second type of packet—UDP/IP—is a

low-latency packet. Specifically, RFC 768 states that UDP has a “minimum of protocol mechanism.” RFC 768, 1; *see also* Jorgensen [0363]; Bastone, 6; Oliver, 1; Reynders, 131.

371. Therefore, RFC 791, RFC 793, and RFC 768 render claims 10 and 20 obvious.

## **VII. CONCLUSION**

372. In my opinion, based on my review of the '055 patent, the materials referenced herein, and my knowledge of what a person having ordinary skill in the art would have known at and before the '055 patent's priority date about the technology at issue, a person having ordinary skill in the art would have understood all of the claim elements and limitations of challenged claims 1, 5, 10, 11, 15, and 20 to be rendered obvious by Kawakami; and claims 1, 4, 5, 7, 9-11, 14, 15, 17, 19, and 20 to be rendered obvious by Reynders and to be rendered obvious by RFC 791, RFC 793, and RFC 768, as set forth above. Accordingly, challenged claims 1, 4, 5, 7, 9-11, 14, 15, 17, 19, and 20 should be found unpatentable.

373. I reserve the right to supplement my opinions in the future to respond to any arguments or positions that the Patent Owner may raise, taking account of new information as it becomes available to me.

Declaration of Bruce McNair in Support of  
Petition for *Inter Partes* Review of  
U.S. Patent No. 9,485,055

I hereby declare that all statements made herein of my own knowledge are true and that all statements made 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 so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on April 21, 2022 at Holmdel, NJ



---

Bruce McNair

# Appendix A

# Bruce McNair

<b>Career Summary</b>	<ul style="list-style-type: none"><li>• More than 30 years engineering research, design, development, systems engineering experience in communications systems (including extensive background in wireless communications and system/network security)</li><li>• Well-rated member of one of world's most highly respected R&amp;D organizations, recognized for breadth, depth and practicality of expertise</li><li>• Extensive experience teaching technical short courses for premiere educational programs</li></ul>
<b>Research interests</b>	<ul style="list-style-type: none"><li>• High speed wireless data networking</li><li>• System/network security</li><li>• Real-time digital signal processing</li><li>• Software-Defined Radio technology</li></ul>
<b>Present Organization(s)</b>	<ul style="list-style-type: none"><li>• Stevens Institute of Technology,</li><li>• Novidesic Communications, LLC</li></ul>
<b>Job Title(s)</b>	<ul style="list-style-type: none"><li>• Distinguished Service Professor of Electrical and Computer Engineering</li><li>• Founder, Chief Technology Officer</li></ul>
<b>Education</b>	<p>M.S., E.E., Stevens Institute of Technology, 1974 B.E. (with Honor), Stevens Institute of Technology, 1971 completed qualifiers and course work for PhD in Computer Science at Stevens</p>
<b>Relevant Experience</b>	<p>2002 – present – Distinguished Service Professor of Electrical and Computer Engineering, Stevens Institute of Technology, Hoboken, NJ; Design and manage the Senior Design Project, a two semester program that forms a substantial portion of the senior year in the engineering program. This project comprises 40% of the seniors' efforts and serves to provide real-world engineering design experiences for the student. Conduct research in wireless systems, particularly security needs and solutions.</p> <p>2002 – present – CTO, Novidesic Communications, LLC, Holmdel, NJ; Founded a technical consulting company, providing expert witness support, telecommunications, wireless networking, security, software, computing, and web site design guidance to individuals and small businesses. Current clients include health care facilities, patent attorneys, telecommunications providers.</p>

**Relevant  
Experience**  
(continued)

1994 to 2002 (retired) -- Wireless Systems Research Department, AT&T Bell Labs/ AT&T Labs - Research, Holmdel/Red Bank/Middletown, New Jersey  
Research Staff Member/Principal Technical Staff Member/Technology Consultant; Investigating high-speed, high-mobility wireless data communications systems for untethered access to high speed global networks. Proposed and investigated IEEE 802.11(a & b) physical and MAC layer to outdoor, high mobility environment. Efforts involve system architecture, system control, real-time DSP programming in C, high-speed hardware design, RF design, analog, RF interfacing, Matlab/SIMULINK simulation and experimental investigations. Responsible for complete design, implementation and characterization of a multiple TMS320C40-based 384 kb/s OFDM transmission system and definition/design of advanced signal processing platforms. Recent research extends results to 5-40 Mb/s with TMS320C62/FPGA-based platform and incorporates 802.11a and DVB-T technology. Previous research involved speech quality/data rate enhancements to IS-136, the North American TDMA cellular standard.

1987 to 1994 -- Security and System Reliability Architecture Group, AT&T Bell Labs, Holmdel, New Jersey  
Technical Manager; Created, staffed, and led a group of security, systems reliability and fraud control experts to assess security/quality of operations systems, communications networks, operating systems, and work centers and to recommend, specify, and prototype cost effective improvements. Created corporate process to build security into the development process. Transformed small (2 person) corporate-funded activity into well-staffed (multi million dollar), successful business unit supported program. Served as security technologies subject matter expert for AT&T Corporate Security and other (AT&T and outside) organizations

1982 to 1987 -- various AT&T Bell Labs organizations, MTS - Supervisor; System Design, Exploratory Development, Applied Research, and Final Product Development of secure voice terminals, modems, speech recognition and speaker verification systems, encryption devices, and network management systems

1978 - 1982 -- various AT&T Bell Labs organizations, Member of Technical Staff, System design, digital hardware design and simulation of wide area (X.25) data communications networks and high speed data transmission techniques for voiceband modems. Led \$1M IR&D secure voice terminal initiative, ultimately resulting in promotion to MTS-Supervisor and laying groundwork for AT&T's breakthrough success in STU-3 program

**Relevant  
Experience**  
(continued)

1971 - 1973, 1974 - 1978 -- U.S Army Communications R&D Command, Fort Monmouth, NJ. GS-7, 9, 11 & 12 Electronic Engineer (GS-0855)  
Development of tactical military radio communications equipment, specializing in modulation, data transmission, communications security and electronic warfare (frequency hopping and direct sequence spread spectrum) for the SINCGARS VHF-FM radio system.

1973 - 1974 -- ITT Defense Communications Division, Nutley, New Jersey.  
Member of Technical Staff; Designed, developed and tested software and digital hardware for portable satellite terminals and a pioneering hardware implementation of 2400 bps Linear Predictive Coder (LPC) secure speech transmission system.

**Patents,  
Presentations  
and  
Publications**

14 U.S. patents granted (6 more pending) in areas such as data transmission, cryptographic techniques, speech processing, video processing, security systems, user authentication, fraud control, synchronization, dynamic channel assignment, location determination techniques, etc.

Presented numerous well-rated short courses in Digital Communications, Digital Telephony, Digital Signal Processing, and Wireless Communications, & Security. Course sponsors included: Bell Labs In-hours Continuing Education Program, George Washington University, University of Maryland, UCLA Extension, Johns Hopkins University – Organizational Effectiveness Institute, Berlin (Germany) Continuing Engineering Education Program, Monmouth University, and the Fort Monmouth Education Center.

Several papers presented at IEEE Vehicular Technology and other Conferences and published in AT&T Technical Journal and IEEE Communications Magazine on various topics in wireless systems and security.

**Skills**

System/network architecture, communications system design, digital hardware design, RF design, signal processing, real-time DSP programming, proof-of-concept prototyping, designing and conducting laboratory research experiments, OFDM, TDMA/IS-136, FPGA, encryption, computer network security, threat assessment, data communications protocols, computer architecture, system & link-level simulation, UNIX/Linux, Windows, C/C++, Matlab/Simulink, MathCad, PASCAL, Algol, SNOBOL, VHDL, FORTRAN. Recruitment, development and management of highly effective technical staff. Highly effective technical presentations and training sessions to any level audience. Well developed technical writing skills.

**Other  
information**

U.S Citizen. Have held Top Secret and Secret/CRYPTO security clearances with COMSEC access (active clearances from 1971-1978 & 1981-1997).

Mentored two AT&T Labs Fellowship Program (ALFP) participants, three students in the MentorNet program, 5 Bell Labs Early Career Advisory Program (ECAP) participants, numerous summer students (graduate and undergraduate), several new employees, and all of the staff in groups I have managed.

Senior member, IEEE

Identified by Rutberg & Co. Investment Bankers (San Francisco) as member of a group of 213 "Top Wireless Influencers: 2002"

Member of the Council of Communications Advisors

Amateur radio operator licensed since 1963, Amateur Extra Class since 1970

**Contact  
Information**

Home: P.O. Box 129  
Holmdel, NJ 07733  
(732) 264-5244 FAX (732) 335-9709 cellular (732) 371-5026  
bmcnair@novidesic.com  
<http://www.novidesic.com>

Stevens: Stevens Institute of Technology  
Electrical and Computer Engineering Department  
Castle Point on Hudson  
Hoboken, NJ 07030  
(201) 216-5549  
bmcnair@stevens-tech.edu  
<http://koala.ece.stevens-tech.edu/~bmcnair>

6/03



**US Patents**  
(numerous  
related foreign  
patents  
pending or  
granted)

- "Dynamic Channel Assignment," US Patent Application #20010048691, filed March 2001.
- "Security System Providing Lockout for Invalid Access Attempts," US Patent #5,559,505, September 24, 1996.
- "Telecommunications Fraud Detection Scheme," US Patent #5,504,810, April 2, 1996.
- "Authenticator Card and System," US Patent #5,450,491, September 12, 1995.
- "Secure Telecommunications," US Patent #5,392,357, February 21, 1995.
- "Data Message Storage and Pickup Service," US Patent #5,392,336, February 21, 1995.
- "System and Method for Granting Access to a Resource," US Patent #5,375,244, December 20, 1994.
- "Secure Teleconferencing," US Patent #5,353,351, October 4, 1994.
- "Method and Apparatus for Processor Based Encryption," US Patent #5,278,905, January 11, 1994.
- "Centralized Security Control System," US Patent # 5,276,444, January 4, 1994.
- "Technique for Voice Based Security System," US Patent #5,265,191, November 23, 1993.
- "Video Scrambling System", US Patent # 5,206,906, April 27, 1993.
- "Cryptographic Transmission System," US Patent #4,642,424, February 10, 1987.
- "Processing of Encrypted Voice Signals," US Patent #4,608,455, August 26, 1986.
- "Control of Coefficient Drift for Fractionally Spaced Equalizers," US Patent #4,376,308, March 8, 1983

several other unpublished US patents recently filed

**Publications**

- Chuang, J., Cimini, L., Li, G., Lin, L., McNair, B., Sollenberger, N., Suzuki, M., Zhao, H., "High Speed wireless data access based on combining EDGE with wideband OFDM," *IEEE Communication Magazine*, November, 1999.
- D'Angelo, D.M., McNair, B., Wilkes, J.E., "Security in Electronic Messaging Systems," *AT&T Technical Journal*, Volume 73, Number 3, 1994.

**Conference  
Papers**

- Cimini, L., Leung, K., McNair, B., Winters, J. "Outdoor IEEE 802.11b Cellular Networks: MAC Protocol Design and Performance," *Proc. ICC 2002*, New York, NY, April 2002
- Clark, M., Leung, K., McNair, B., Kostic, Z., "Outdoor IEEE 802.11b Cellular Networks: Radio Link Performance", *Proc. ICC 2002*, New York, NY, April 2002.
- McNair, B., "Software Radio – the Commercial Perspective," *Proc. IEEE Sarnoff Symposium*, Princeton, NJ, March 2002.

**Conference  
Papers  
(continued)**

- Zou, H., Daneshmand, B., McNair, B., "An Integrated OFDM Receiver for High-Speed Mobile Data Communications," *Proc. IEEE Globecom 2001*, San Antonio, TX, Oct. 2001.
- McNair, B., "Future Directions for Wireless Communications," *Supercomm2001*, Atlanta, GA, June, 2001.
- Cimini, L., McNair, B., "OFDM for High Data Rate, High-Mobility, Wide-Area Wireless Communications," *Proc. IEEE Sarnoff Symposium*, Princeton, NJ, March, 2001.
- Cimini, L., McNair, B., Sollenberger, N., "Implementation of an Experimental 384 kb/s Radio Link for High-Speed Internet Access," *Proc. IEEE Vehicular Technology Conference VTC2000*, Boston, MA, September, 2000.
- Cimini, L., McNair, B., Sollenberger, N., "Performance of an Experimental 384 kb/s 1900 MHz Radio Link In a Wide-Area High-Mobility Environment," *Proc. IEEE Vehicular Technology Conference VTC2000*, Boston, MA, September, 2000.
- McNair, B., Cimini, L., Sollenberger, N., "A Robust Timing and Frequency Offset Estimation Scheme for Orthogonal Frequency Division Multiplexing (OFDM) Systems," *Proc. IEEE Vehicular Technology Conference, VTC99*, Houston, TX, May 1999.
- McNair, B., Gupta, S., Kostic, Z., Sollenberger, N., "Experimental Results for Extensions to the IS-136 TDM Standard Based on Higher Level Modulation, Coherent Detection, and Equal Gain Antenna Combining," *Proc. IEEE Vehicular Technology Conference, VTC99*, Houston, TX, May 1999.
- Kostic, Z., McNair, B., Sollenberger, N., "Experimental Performance Results of an Indoor Wireless Extension of IS-136 Based on pi/8 D8PSK, Coded Modulation, and Antenna Diversity," *Proc. IEEE Vehicular Technology Conference, VTC98*, Ottawa, Canada, May 1998.
- McNair, B., "The Effectiveness of Preselection Diversity for Indoor Wireless Systems," *Proc. Int. Conf. on Universal Personal Communications*, San Diego, CA, Oct. 1997.

**University  
Courses  
At Stevens**

- Graduate:
  - EE584/TM684CE – Wireless System Security: Fall '03
  - EE585WS – Physical Design of Wireless Communications: Fall '03
  - NiS/CpE691CE – Information Systems Security: Fall '02
- Undergraduate:
  - EE/CpE 415-416/423/424 – Senior Design: Fall '02 – Spring '03, Fall '03 – Spring '04
  - EE/CpE 345 – Modeling and Simulation: Fall '02, Spring '03, Fall '03

## Short Courses

- "Digital Signal Processing - Principles, Architecture, and System Applications," 3 day course - 5 sessions from March 1998 to present
  - *Organizational Effectiveness Institute (originally Johns Hopkins University's continuing education program),*
- "Wireless Digital Communications Systems: Components, Specifications, Test and Evaluation," 3 day course - 2 sessions from November, 1999 to present
  - *Organizational Effectiveness Institute*
- "Security in Digital Communications Networks," 1 day course - 3 sessions from November, 1985 to April, 1990
  - *Bell Labs Architecture Area Adopt a University Program: Grambling State University*
  - *Monmouth University*
- "Digital Telephony," 3-5 day course - 5 sessions from October, 1984 to March, 1989.
  - *Monmouth University*
  - *Fort Monmouth Education Center*
  - *Berlin (F.R.G.) Continuing Engineering Education Program*
- "Digital Communications & Applications," 3 day course - 7 sessions from November, 1984. to November, 1986
  - *University of Maryland*
  - *Fort Monmouth Education Center*
  - *UCLA Extension University*
- "Digital Communications, " 2 days of a 5 day course - 2 sessions from December, 1981 to June 1982, presented with Allen Gersho, N.S. Jayant and David Falconer.
  - *George Washington University*
- "Data Communications for the System Designer," Fall 1980 Semester
  - *Bell Labs In-Hours Continuing Education Program*