IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of:	Arndt Mueller	
U.S. Patent No.:	8,320,566	Attorney Docket No.: 45035-0027IP1
Issue Date:	November 27, 2012	
Appl. Serial No.:	12/580,227	
Filing Date:	October 15, 2009	
Title:	METHOD AND APPARATUS FOR PERFORMING CONSTELLATION SCRAMBLING IN A MULTIMEDIA HOME NETWORK	

DECLARATION OF TIM A. WILLIAMS, PH.D. IN SUPPORT OF DISH'S PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 8,320,566

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CHALLENGED CLAIMS[1]

Claim 1	
[1pre]	A method for communications transmission using orthogonal frequency division multiple access on a network comprising:
[1a]	a) providing a plurality of transmitting network devices with a set of available subcarriers for orthogonal frequency division multiple access;
[1b]	b) providing a corresponding element of a pseudorandom noise sequence for each subcarrier of the set of available subcarriers;
[1c]	c) allocating a subset of the set of available subcarriers to each of the transmitting network devices;
[1d]	d) [i] a transmitting network device of the plurality of devices [ii] mapping a packet onto a plurality of used subcarriers of its allocated subset of available subcarriers, wherein the step of [iii] mapping the packet comprises mapping the packet onto a plurality of quadrature amplitude modulated symbols to be transmitted on the used subcarriers;

[1] All elements and subpart lettering added.

[1e]	e) the transmitting network device [i] performing a predetermined transformation on a quadrature amplitude modulated symbol [ii] using the element of the pseudorandom noise sequence corresponding to the used subcarrier;
[1f]	f) the transmitting network device transmitting the transformed symbol to a receiving network device.

Claim 2	
[2pre]	The method of claim 1, wherein the steps of providing a corresponding element of a pseudorandom noise sequence and performing a predetermined transformation comprise:
[2a]	a) the transmitting network device [i] receiving an initial pseudorandom noise sequence element from a pseudorandom noise sequence generator, [ii] the initial pseudorandom noise sequence element corresponding to a first available subcarrier and [iii] transforming the symbol to be transmitted on the first available subcarrier if the first available subcarrier is a used subcarrier; and

[2b]	b) the transmitting network device advancing the pseudorandom noise generator to receive a next element of the pseudorandom noise sequence corresponding to a next available subcarrier and transforming the symbol to be transmitted on the next available subcarrier if the next available subcarrier is a used subcarrier.

Claim 3	
[3]	The method of claim 2, wherein the step of the transmitting network device advancing the pseudorandom noise generator is repeated until a symbol to be transmitted on a last used subcarrier is transformed.

Claim 4	
[4]	The method of claim 1, wherein the pseudorandom noise sequence comprises a PN-15 sequence.

Claim 5	
[5]	The method of claim 4, wherein the step of performing the predetermined transformation comprises rotating the quadrature amplitude modulated symbol by 180° if the element of the pseudorandom noise sequence is a ‘1’ and not modifying the quadrature amplitude modulated symbol if the element of the pseudorandom noise sequence is a ‘0’.

Claim 6	
[6]	The method of claim 4, wherein the receiving network device comprises a network coordinator and wherein the packet comprises a resource reservation request packet.

Claim 12	
[12]	The method of claim 4, wherein the method is performed by a network coordinator and wherein first and second scrambled orthogonal frequency division modulation symbols are contained in a resource reservation request packet.

EXHIBIT LIST

DISH-1001	U.S. Patent 8,320,566 to Mueller et al. (the "'566 patent")
DISH-1005	Prosecution History of the '566 Patent
DISH-1006	U.S. Patent Application Publication No. 2008/0112359 A1 to Cleveland et al. ("Cleveland")
DISH-1007	U.S. Patent 5,682,376 to Hayashino et al. ("Hayashino")
DISH-1008	"Multi-Carrier and Spread Spectrum Systems: From OFDM and MC-CDMA to LTE and WiMAX" Textbook by K. Fazel ("Fazel")
DISH-1009	U.S. Patent 6,961,369 to Tzannes et al. ("Tzannes")
DISH-1010	English translation of Japanese Patent 2006-197520 to Nanba et al. ("Nanba")
DISH-1011	U.S. Patent Application Publication No. 2008/0043861 ("Moffat")
DISH-1012	U.S. Patent 7,236,554 to Gupta et al. ("Gupta")
DISH-1013	U.S. Patent 8,526,412 to Vijayan et al. ("Vijayan")
DISH-1014	"Pseudo noise sequences for engineers" by R.N. Mutagi ("Mutagi")
DISH-1015	Wei-Chia Ting, Low-Complexity Inner Receiver Design for IEEE 802.16 OFDMA Systems (July 2007) (Ph.D. thesis, National Chiao-Tung University) ("Ting")
DISH-1016	U.S. Patent Application Publication No. 2008/0298241 A1 to Yitshak Ohana et al. ("Ohana")

DISH-1017	U.S. Patent Application Publication No. 2008/0233966 A1 to Scheim et al. (“Scheim”)
DISH-1018	Declaration of June Munford
DISH-1022	U.S. Patent Application Publication No. 2007/0133386 to Kim et al. (“Kim”)
DISH-1023	U.S. Patent 7,054,296 to Sorrells et al. (“Sorrells”)
DISH-1024	U.S. Patent Application Publication No. 2005/0287964 to Tanaka et al. (“Tanaka”)
DISH-1025	U.S. Patent Application Publication No. 2008/0076432 to Senarath et al. (“Senarath”)
DISH-1026	Stephen Boyd, “Multitone Signals with Low Crest Factor,” IEEE Transactions on Circuits and Systems, Vol. Cas-33 No. 10, Oct. 1986
DISH-1027	Robert Chang, “A Theoretical Study of Performance of an Orthogoal Multiplexing Data Transmission Scheme,” IEEE Transactions on Communication Technology, Vol. Com.-16, No. 4, Aug. 1968
DISH-1028	Leon Couch, ed., Modern Communication Systems, Principles and Applications (1995)
DISH-1029	M.L. Doelz, Binary Data Transmission Techniques for Linear Systems, PROCEEDINGS OF THE IRE, 656, May 1956
DISH-1030	U.S. Patent No. 6,657,949 to Jones, IV et al. (“Jones”)
DISH-1031	U.S. Patent No. 7,363,038 to Kim et al.
DISH-1032	Didem Kivanc et al., Subcarrier allocation and power control for OFDMA. Conference Record of the Thirty-Fourth Asilomar

	Conference on Signals, Systems and Computers (Cat. No.00CH37154), 1, 147-151 vol.1. (2000) ("Kivanc")
DISH-1033	Anton Monk et al., The Multimedia Over Coax Alliance, Proceedings of the IEEE, Vol. 101, No. 11, Nov. 2013 ("Monk")

DECLARATION OF TIM A. WILLIAMS

I, Tim A. Williams, declare:

I. QUALIFICATIONS AND BACKGROUND INFORMATION

1. I am an independent consultant. All of my opinions stated in this declaration are based on my own personal knowledge and professional judgment. In formulating my opinions, I have relied upon my knowledge, training, and experience in the relevant art.

2. I am over 18 years of age, and, if I am called upon to do so, I would be competent to testify as to the matters set forth herein. Although my qualifications are stated more fully in my curriculum vitae (Appendix A), I provide below a brief summary of my qualifications.

3. I earned a Bachelor of Science degree in Electrical Engineering (BSEE) from Michigan Technological University in 1976. In 1982, I earned a Master's degree, also in Electrical Engineering (MSEE), from the University of Texas at Austin. I earned a Doctor of Philosophy (Ph.D.), also from the University of Texas at Austin, in 1985. My doctorate dissertation was "Digital Signal Processing Techniques for Acoustic Log Data." In 1991, I earned a Master of Business Administration degree from the University of Texas at Austin as well.

4. I have over 40 years of professional experience in wireless communications and telecom technology, including roles in large corporations as well as start-ups and consulting work.

5. For example, from 1979 through 1991, I held the positions of Senior Engineer, Senior Member of the Technical Staff, and Member of the Technical Staff at Motorola, Inc. My work at Motorola included serving as business manager, project leader, and senior technical member for projects relating to the development of various cellular modems, transceivers, and transcoders.

6. As another example, in 1991, I co-founded Wireless Access, Inc., a start-up company focused on the Narrow Band PCS equipment market and which developed the over-the-air protocols, subscriber equipment, and integrated circuits to deploy 2-way paging services. I held the positions of Co-Founder, Chief Technical Officer, Vice President of Engineering, and Vice President of Business Strategy at Wireless Access until it was sold to Glenarye Electronics in 1998.

7. As another example, between 1998 and 2000, I was the Chief Technology Officer and Advisory Board Member of Picazo Communications, which built and sold software PBXs Telephony equipment using VoIP and Circuit Switched Technologies.

8. As another example, in 2004, I founded DoceoTech Inc., which provides training for engineers in Wireless, Networking, and Telephony technologies. Since 2004, I have served as DoceoTech's Chairman.

9. I hold over 25 United States patents in wireless and signal processing technology, as well as numerous patent applications in the same field. Additionally, I am a Patent Agent registered with the U.S. Patent and Trademark Office since January 2002. Further, I have served as a technical expert in multiple patent proceedings.

10. These and other professional experiences, as well as other qualifications are described in my CV (Appendix A).

11. I have been retained on behalf of DISH to analyze and offer technical opinions relating to U.S. Patent No. 8,320,566 ("the '566 patent") and prior art references relating to its subject matter. In forming my opinions, I read and considered the '566 patent, its prosecution history, and the exhibits listed in the exhibit list.

12. I have no financial interest in any party to this proceeding or in the outcome of this proceeding. I am being compensated for my work as an expert on an hourly basis. My compensation is not dependent on the outcome of these proceedings or the content of my opinions.

13. For any testimony I may give in this matter, I may use some or all of the documents and information cited to, referred to, and identified in this declaration, as well as any additional materials that are entered into evidence in this proceeding. Figures that appear within this document have been prepared with the assistance of Counsel and present my understanding of the '518 Patent and the prior art discussed below.

II. LEGAL PRINCIPLES

A. Obviousness

14. I have been informed that a patent claim is invalid as "obvious" under 35 U.S.C. § 103 in light of one or more prior art references if it would have been obvious to a POSITA, taking into account (A) the scope and content of the prior art, (B) the differences between the prior art and the claims, (C) the level of ordinary skill in the art, and (D) any so called "secondary considerations" of non-obviousness, which include: (i) "long felt need" for the claimed invention, (ii) commercial success attributable to the claimed invention, (iii) unexpected results of the claimed invention, and (iv) "copying" of the claimed invention by others.

15. For purposes of my analysis and because I know of no indication from the patent owner or others to the contrary, I have applied a date of October 16, 2008,

as the date of invention in my obviousness analyses, although in many cases the same analysis would hold true even at an earlier time than October 16, 2008.[2]

16. I have been informed that a claim can be obvious in light of a single prior art reference or multiple prior art references. To be obvious in light of a single prior art reference or multiple prior art references, there must be a reason to modify the single prior art reference, or combine two or more references, in order to achieve the claimed invention. This reason may come from a teaching, suggestion, or motivation to combine, or may come from the reference or references themselves, the knowledge or "common sense" of one skilled in the art, or from the nature of the problem to be solved, and may be explicit or implicit from the prior art as a whole. I have been informed that the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. I also understand it is improper to rely on hindsight in making the obviousness determination.

17. I have been informed that a claim can be obvious if the prior art contained a base device, system, or method upon which the claim can be seen as an

[2] The earliest-filed application to which the '566 patent claims priority, U.S. Provisional Application No. 61/105,942, was filed on October 16, 2008. DISH-1001 (Face of Patent).

improvement; the prior art contained a known technique that is applicable to the base device, system or method; one of ordinary skill in the art would have been capable of applying the known technique to the base device, system, or method that was ready for improvement; and the results of applying the known technique to the base device, system or method would have been predictable to one of ordinary skill in the art.

III. OVERVIEW OF CONCLUSIONS

18. Based on my review of the materials considered and my knowledge and experience in the telecommunications field, it is my opinion that a person of ordinary skill in the art ("POSITA") would have found claims 1-6 and 12 of the '566 patent obvious at the time of the alleged invention.

19. It is my opinion that a POSITA would have found claims 1-3 obvious over Cleveland and Hayashino. I present my opinion and analysis under Ground 1A.

20. It is my opinion that a POSITA would have found claim 4 obvious over Cleveland, Hayashino, and Mutagi. I present my opinion and analysis under Ground 1B.

21. It is my opinion that a POSITA would have found claim 5 obvious over Cleveland, Hayashino, Mutagi, and Ting. I present my opinion and analysis under Ground 1C.

22. It is my opinion that a POSITA would have found claims 6 and 12 obvious over Cleveland, Hayashino, Mutagi, and Ohana. I present my opinion and analysis under Ground 1D.

23. It is my opinion that a POSITA would have found claims 1-3 obvious over Scheim and Tzannes. I present my opinion and analysis under Ground 2A.

24. It is my opinion that a POSITA would have found claim 4 obvious over Scheim, Tzannes, and Mutagi. I present my opinion and analysis under Ground 2B.

25. It is my opinion that a POSITA would have found claim 5 obvious over Scheim, Tzannes, Mutagi, and Ting. I present my opinion and analysis under Ground 2C.

26. It is my opinion that a POSITA would have found claims 6 and 12 obvious over Scheim, Tzannes, Mutagi, and Ohana. I present my opinion and analysis under Ground 2D.

IV. CLAIM CONSTRUCTION

27. I understand that, for purposes of my analysis in this *inter partes* review proceeding, the terms appearing in the patent claims should be interpreted under the *Phillips* standard. In that regard, I understand that the best indicator of claim meaning is its usage in the context of the patent specification as understood by a

POSITA. I further understand that the words of the claims should be given their plain meaning unless that meaning is inconsistent with the patent specification or the patent's history of examination before the Patent Office. I also understand that the words of the claims should be interpreted as they would have been interpreted by a POSITA at the time of the invention was made (not today).

28. Because I do not know the exact date the invention as claimed was made, I have used the earliest possible priority date of the '566 patent as the point in time for claim interpretation purposes. That date is October 16, 2008.

V. THE '566 PATENT

A. Overview of the '566 Patent (DISH-1001)

29. The '566 patent is directed to "[s]ystems and methods . . . that allow multiple transmitting network devices to transmit under an orthogonal frequency divisional multiple access (OFDMA) mode to a receiving network device." DISH-1001 (Abstract).

30. The '566 patent acknowledges that "communication networks are now commonplace in many home and office environments" and that "there is a growing demand for the ability to connect content devices (e.g., televisions, DVD players and records, digital cameras, speakers, video cameras, etc.), computing devices, I/O devices, home appliances and modems." DISH-1001 at 1:32-40. Figure 1 of the '566 patent depicts such a network. DISH-1001 at 3:60-65 (depicting

"examples of equipment and other electronic devices or nodes that might be found in a typical home-networking environment, such as a network defined by MoCA").

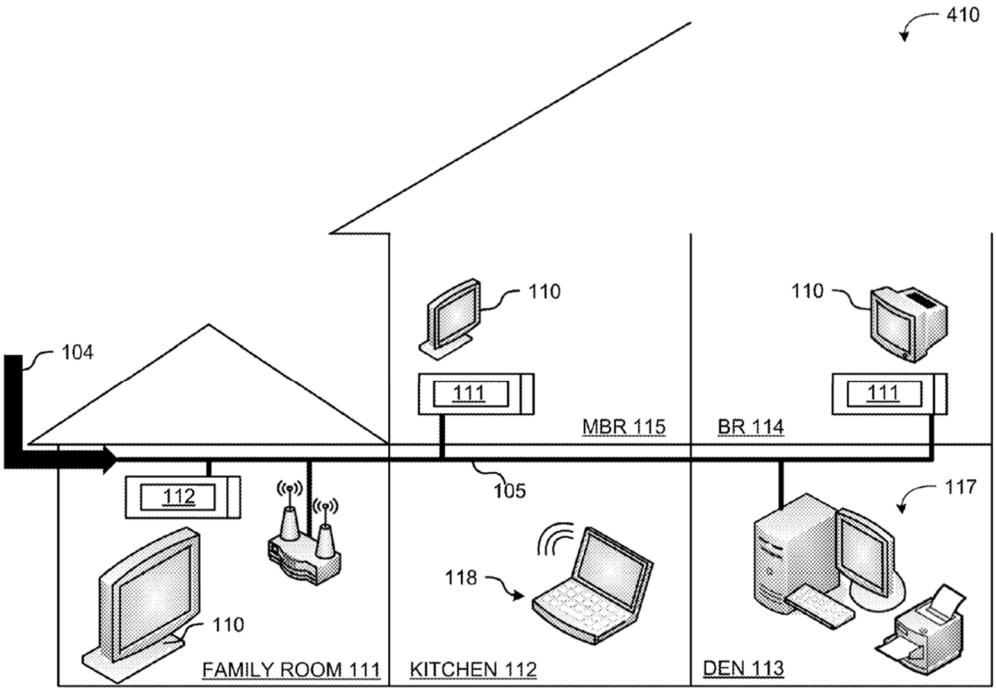


Fig. 1

FIGURE 1 OF '566 PATENT

31. While the '566 patent explains that connected device networks like that in Figure 1 were commonplace, it also acknowledges that "[a]rchitects of these and other networks, and indeed communications channels in general, have long struggled with the challenge of managing multiple communications from various devices across a limited channel. Accordingly, network architects have come up with various solutions to arbitrate disputes or otherwise allocate bandwidth among

the various communicating devices, or clients, on the network." DISH-1001 at 2:4-11.

32. The '566 patent goes on to list several existing solutions for optimizing data throughput in a home or other similar setting. For example, "[s]chemes used in well known network configurations such as token rings, Ethernet, and other configurations . . . allow sharing of the available bandwidth" of a network. DISH-1001 at 2:4-14. The '566 patent also describes the Multimedia over Coax Alliance ("MoCA"), which developed a standard "for distributing digital entertainment over the available bandwidth" of preexisting coaxial cable networks to address "the growing demand for a digital home networking market." DISH-1001 at 1:59-66.

33. As shown in Figure 1 above, "[a] MoCA network includes a plurality of client nodes, such as TVs 110, set top boxes 111 and computers 117, 118 . . . configured with a communication device that allows these devices to operate as a client node on the MoCA network." DISH-1001 at FIG. 1, 4:30-35. When setting up a MoCA network, "one of the client nodes is automatically selected to be a network coordinator (NC)." DISH-1001 at 4:35-37. The network coordinator "allocate[s] network bandwidth" by "schedul[ing] times during which communication occurs[.]" DISH-1001 at 4:35-39. The network coordinator then "communicates the schedule to each client node in 'Media Access Packets' (MAPs)" and allows "network devices to transmit a 'Reservation Request' (RR)

that comprises a request for a certain amount of bandwidth at a certain time." DISH-1001 at 4:40-46 and 5:30-33 ("OFDMA may be used to transmit RRs . . . thereby reducing the duration of the RR period and freeing time for other network communications").

34. In networks using the MoCA standard, "physical layer (PHY) packets are transmitted using orthogonal frequency division multiplexing (OFDM)." DISH-1001 at 4:6-8.

35. OFDMA followed OFDM and has been viewed as an extension of OFDM rather than a new technique.

36. The '566 patent describes OFDM as follows:

> In OFDM, data is modulated onto a plurality of frequency subcarriers. Each subcarrier is modulated using quadrature amplitude modulation (QAM). In QAM, the phases of two carrier waves at the same frequency are modulated. The two subcarriers are termed the quadrature (Q) component and the in phase (I) component. For example, FIG. 2 illustrates a coding scheme for 16-QAM. As the Figure illustrates, both the quadrature and the in phase components may assume any one of four different phases, for a total of sixteen different symbols. By representing such a coding scheme with Q and I as axes of a graph, a constellation diagram may be obtained.

DISH-1001 at 4:8-19. Figure 2 follows:

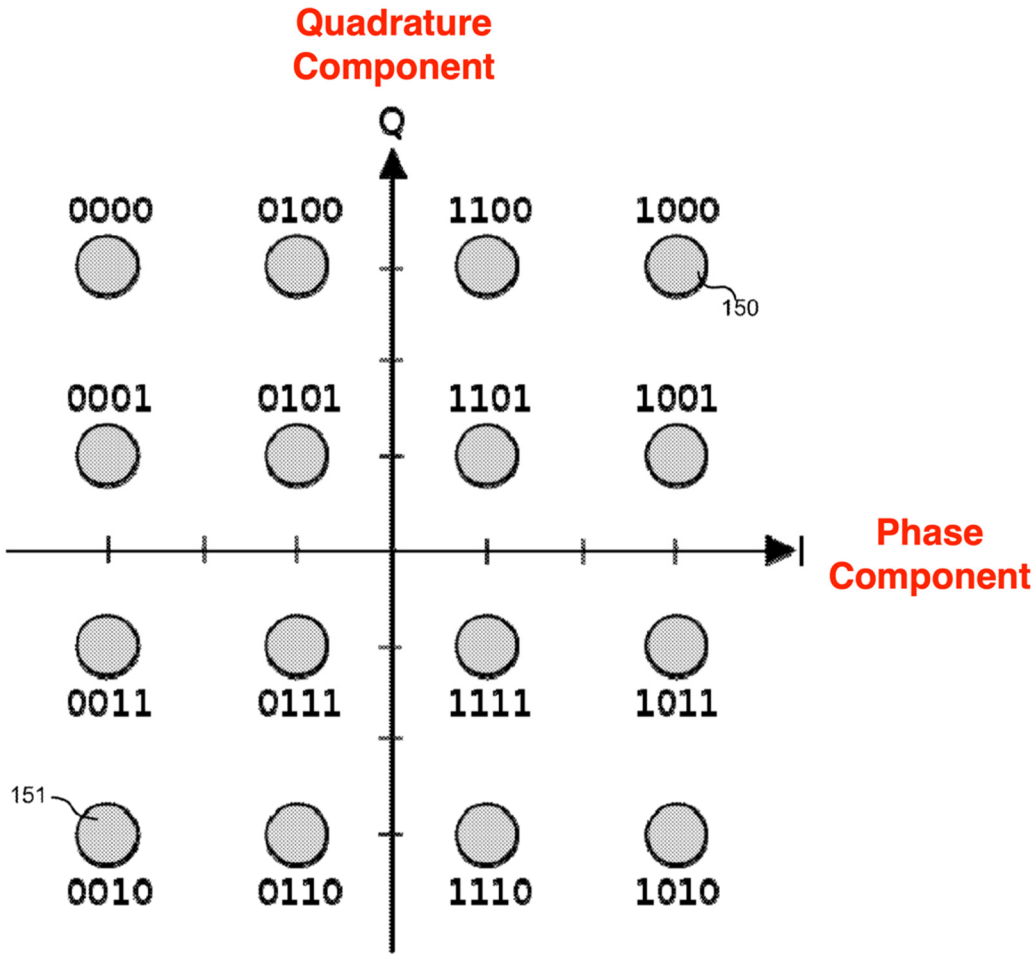


Fig. 2

FIGURE 2 OF THE '566 PATENT

37. OFDM was well-known for both wired and wireless data communications decades before the '566 patent. For example, systems utilizing OFDM date back to the mid-1950s, and industry analysis of OFDM transmission and reception was well-developed by the end of the 1960s. See DISH-1029 (a 1956 paper describing Kineplex, an OFDM system from Collins Radio Co.); DISH-1027 (describing a "theoretical analysis of the performance of an orthogonal multiplexing data

transmission scheme (parallel transmission scheme) subject to a number of degrading factors normally encountered by a practical operating system" from 1968).

38. Similarly, using OFDMA was well known before the priority date. For example, OFDMA was selected for use in LTE and WiMAX standards. DISH-1008 (Fazel) at 228-247 (LTE), 247-286 (WiMax); DISH-1031 (U.S. Pat. No. 7,363,038 explains that WiMax uses an OFDM/OFDMA scheme). Before, and as these standards were being developed, engineers were developing methods to address issues that afflict modulation schemes, including OFDMA, such as signal interference between multiple devices on the network.

39. OFDM and OFDMA systems were also known to suffer from interference due to power concentration, known as the peak-to-average power ratio ("PAR"), across different OFDMA subcarriers (as Hayashino and Tzannes, DISH-1007 and DISH-1009, demonstrate). Engineers had developed solutions to the reduce PAR interference, e.g., by using pseudorandom scrambling to even-out power concentration across an aggregated OFDMA waveform.

40. Further, OFDM using QAM, as used in the MoCA protocol, was also well understood before the '566 patent. For example, in 1995, Leon W. Couch II published *Modern Communication Systems, Principles and Applications* that described a typical QAM modulation process.

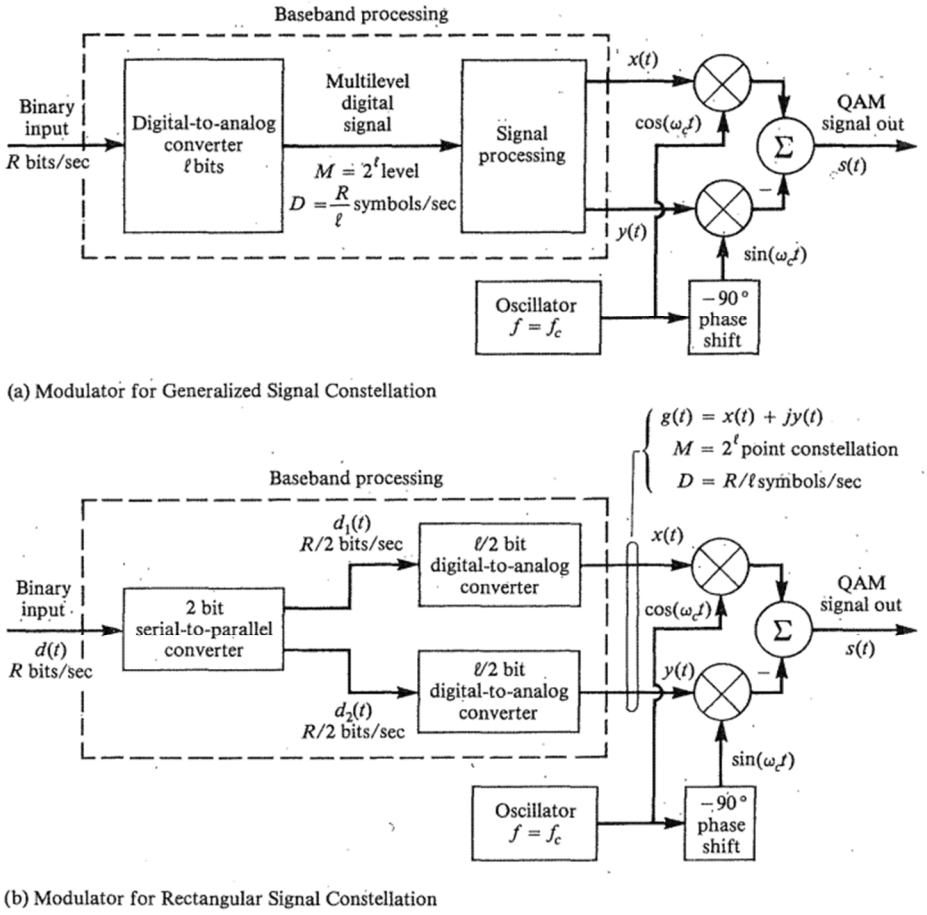


FIGURE 7-13 Generation of QAM signals.

Figure 7-13 of *Modern Communication Systems*

41. The '566 patent applies these same principals to OFDMA, which is an extension of OFDM in which multiple devices share the total available frequency subcarriers. Specifically, each device (often called a "node" or "network node") in an OFDMA network is assigned a subset of available subcarriers of the total. See DISH-1001 at 5:6-8. "These network nodes may then communicate simultaneously on their assigned subcarriers." DISH-1001 at 5:9-10.

42. Figure 3 of the '566 patent depicts an example of an OFDMA network, where "a portion of the subcarriers assigned to node 'A' 203 are labeled with an

'A' and the portion of the subcarriers assigned to node 'B' 204 are labeled with a 'B', while subcarriers that remain available for another node 205 are unlabeled." DISH-1001 at 5:10-15. "[T]he partitioning of the available subcarriers into node-specific portions may be undertaken by a network coordinator or controller," as in the standardized MoCA protocol discussed above, or "the allotment of the available subcarriers to the network nodes may be mutually negotiated." DISH-1001 at 5:15-20.

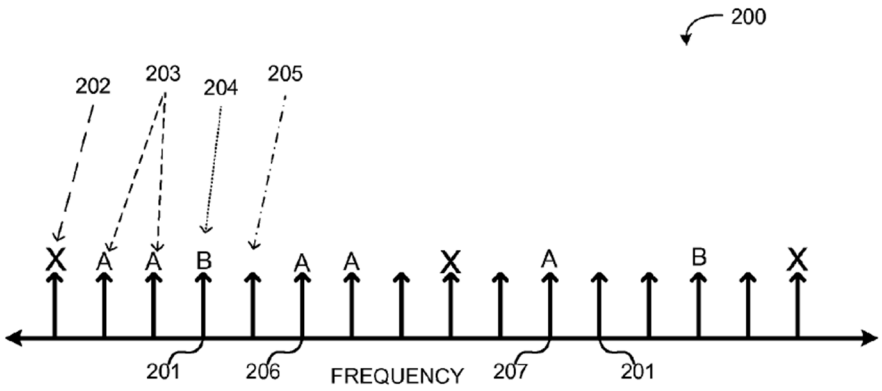


FIGURE 3 OF '566 PATENT

43. A POSITA would have understood that the processes described in the '566 patent for allocating subcarriers to different devices was also well known in the art. For example, "Subcarrier Allocation and Power Control for OFDMA" by Kivanc, et al. tackled "the problem of finding an optimal subcarrier and power allocation strategy for downlink communication to multiple users." DISH-1032, Abstract. The strategies proposed by Kivanc considered typical constraints on real-world

systems such as "BER and transmission rate for users requiring different classes of service." *Id.*

44. The '566 patent also discloses variations on OFDM and OFDMA modulation. Specifically, at Figures 4-11, the '566 patent describes methods for scrambling modulated symbols transmitted over OFDM or OFDMA networks. For example, Figure 4 depicts a system for scrambling an "output symbol stream 253" before transmission, while Figure 8 depicts a corresponding system for unscrambling an incoming "scrambled symbol stream 307." DISH-1001 at 5:59-6:21, 7:56-8:11, FIGS.. 4, 8.

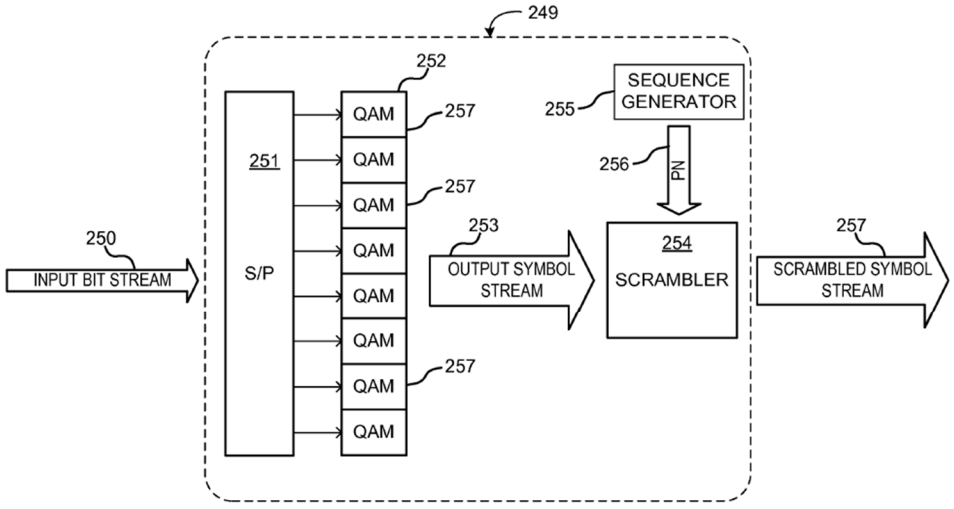


Fig. 4

FIGURE 4 OF '566 PATENT

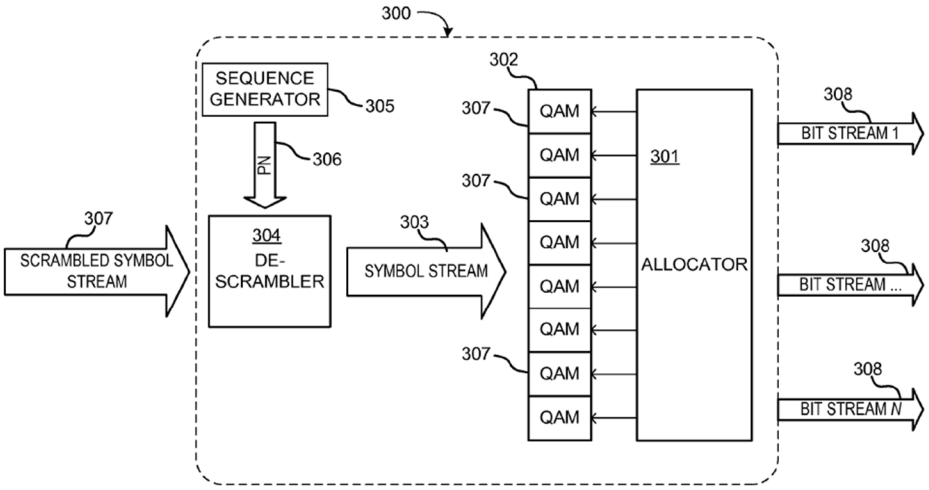


Fig. 8

FIGURE 8 OF '566 PATENT

45. As shown in Figure 4, the "input bit stream 250 may represent a PHY packet." DISH-1001 at 5:62-63. The bit stream is transformed from a "serial bit stream to a parallel stream using serial-to-parallel module 251" and then "presented to a QAM module 252" for modulating the bit stream onto QAM symbols. After the QAM encoding, a scrambling operation is performed on the QAM symbols to generate the "scrambled symbol stream 257" that is transmitted over the network.

> After QAM coding, an output symbol stream 253 comprising a plurality of QAM symbols, and together comprising an OFDM symbol, is provided to a scrambler module 254. The scrambler module 254 uses the output 256 of a sequence generator 255 to perform a constellation scrambling operation on the received QAM symbols, as described below with respect to FIG. 5. In some embodiments, sequence generator module 255 comprises a pseudorandom noise sequence generator and the output

> 256 comprises a pseudorandom noise sequence. The scrambled symbol stream 257 is then provided for further use by the transmitter.

DISH-1001 at 6:11-21.

46. The "descrambling and decoding module" of Figure 8 performs essentially the same operations in reverse order to obtain the original bit stream at the receiver. DISH-1001 at 7:56-8:11.

47. Figures 10 and 11 of the '566 patent provide one example of the scrambling operation performed on the QAM symbols before their transmission. In Figure 10, "a predetermined sequence 340" such as a "pseudorandom sequence of 1's and 0's" is "provided to a mapping function module 342." DISH-1001 at 8:29-34. Separately, "[a]n input symbol stream 341 is coupled to a symbol module 343 to obtain a QAM symbol." DISH-1001 at 8:35-36. "A multiplier 344 multiplies the in phase and quadrature components of the symbols by the result of the mapping function 342. If the current element of the pseudorandom sequence is a 1, then the mapping function module 342 returns a −1, and both the in phase and quadrature components are negated, which is equivalent to a 180° rotation (as viewed on a constellation diagram). Moreover, if the current element of the pseudorandom sequence is a 0, then the mapping function module 342 returns 1, resulting in an identity function that leaves the in phase and quadrature components unchanged.

The output of the multiplier 344 is a scrambled symbol stream 345." DISH-1001 at 8:36-47.

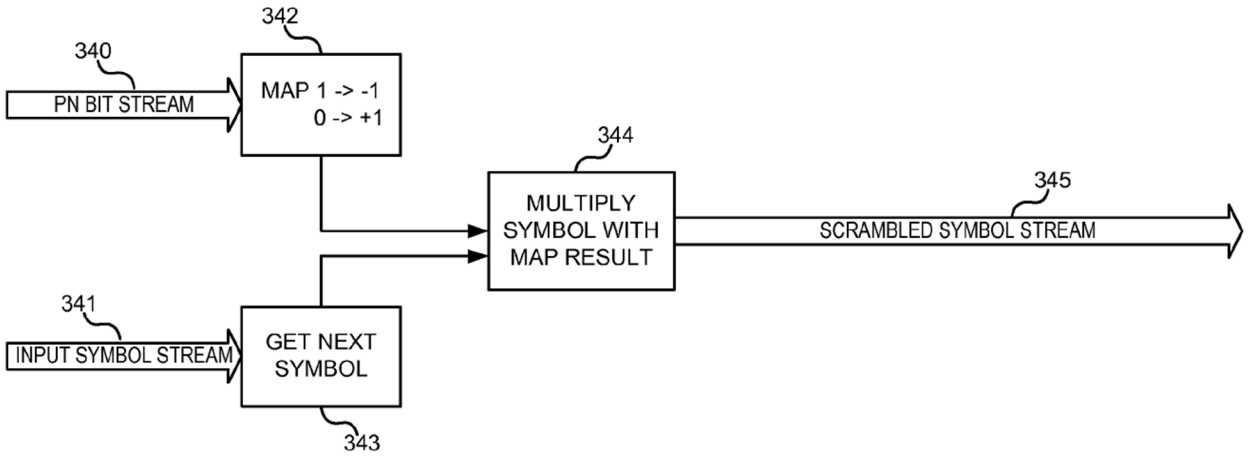


Fig. 10

FIGURE 10 OF '566 PATENT

48. Figure 11 provides an exemplary "pseudorandom sequence generator that may be implemented in an embodiment of the disclosed method and apparatus" such as that in Figure 10. DISH-1001 at 8:55-57. In this example, "a 15th order pseudorandom noise sequence (PN-15(n)), with a generator polynomial $X^{15}+X+1$" is used. DISH-1001 at 8:58-59. When using such a sequence, "each network device in a communications network has such a sequence generator" so that the transmitting and receiving devices can scramble and unscramble the transmitted symbols in appropriately to successfully encode and decode the data. DISH-1001 at 8:60-61, 2:26-29 (explaining that transmitting devices may be configured to

"synchronize their use of the sequence . . . such that the receiving device may view the payload as if it were sent by a single transmitter.").

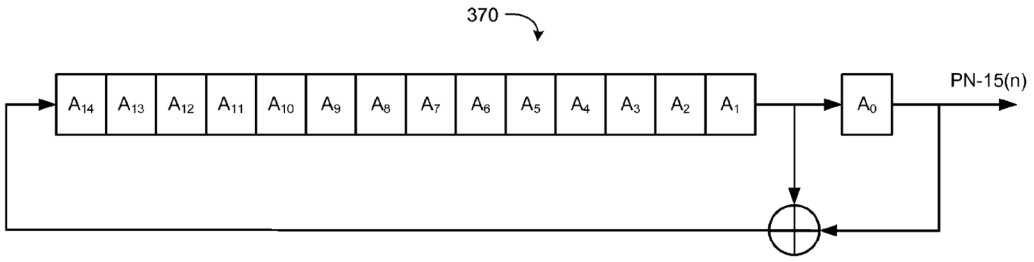


Fig. 11

FIGURE 11 OF '566 PATENT

49. The concept of scrambling signals in multicarrier systems was also well known in the art. For example, in describing multicarrier systems in 1986, Boyd recognized that issues can arise if the phases of all of the subcarriers for a data transmission are aligned. DISH-1026 at 1019. For example, such alignment can result in peaks in signal power (*i.e.*, a high peak-to-average power ratio (PAR)) that can overwhelm a transceiver resulting in signal loss. *Id.*

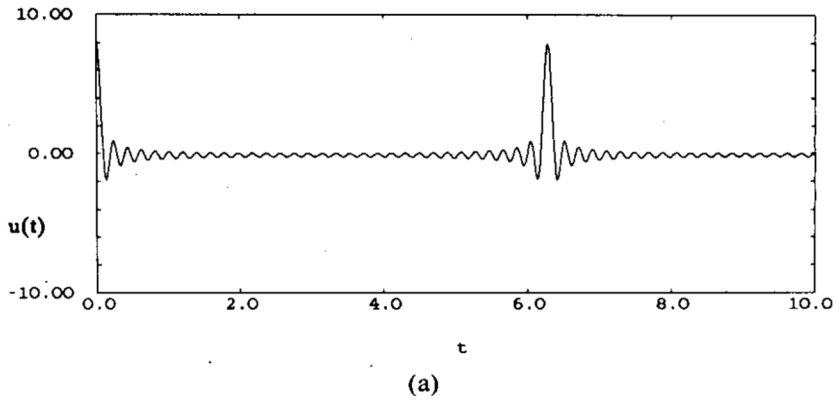


FIGURE 1(a) OF BOYD (DISH-1026)

50. Prior art systems taught that scrambling the phase angles of QAM symbols in a multicarrier system can reduce these peaks in signal power, thereby combatting this problem. See DISH-1030, 5:44-52 ("The phases of the frequency domain symbols within the RA burst are scrambled prior to transmission. . . . The reason for the phase scrambling is that certain combinations of request access data symbols will result in an excessive peak to mean power ratio (PMPR) for the burst as received.").

B. Overview of the Prosecution History (DISH-1005)

51. Arndt Mueller is listed as the inventor of the '566 patent. DISH-1001 (Face of Patent); DISH-1005 at 208. Entropic Communications, Inc. is listed as the Assignee. DISH-1001 (Face of Patent); DISH-1005 at 6-8, 15-16.

52. The application that issued as the '566 patent is Application No. 12/580,227, and it was filed on October 15, 2009. DISH-1001 (Face of Patent).

53. The '566 patent claims priority to two provisional patent applications. DISH-1001 (Face of Patent), 1:9-13; DISH-1005 at 167. Those provisional patent applications include Provisional Application No. 61/144,061, filed on January 12, 2009, and Provisional Application No. 61/105,942, filed on October 16, 2008. *Id.*

54. In the application that issued as the '566 patent, the applicant filed 18 original claims. DISH-1005 at 190-196.

55. The Examiner issued a first Office Action on November 9, 2011. DISH-1005 at 101-122.

56. In the first Office Action, the examiner rejected all 18 original claims. Claims 16-18 were rejected under 35 U.S.C. § 101 as being directed to non-statutory subject matter. DISH-1005 at 104-105. Additionally, claims 1-18 were rejected under 35 U.S.C. § 103 over various prior art patents and patent application publications. *Id.*, 105-122. Specifically, the Examiner rejected claims 1-3, 7-9, and 13-17 over a patent application publication by Kim, et al. (U.S. Patent App. Pub. No. 2007/0133386, "Kim") (DISH-1022) and a patent by Sorrells, et al. (U.S. Patent No. 7,054,296, "Sorrells") (DISH-1023). *Id.*, 105-118. The Examiner rejected claims 4-5 and 10-11 over Kim and Sorrells and further in view of a patent application publication by Tanaka, et al., U.S. Patent App. Pub. No. 2005/0287964 ("Tanaka") (DISH-1024). *Id.*, 118-120. The Examiner also rejected claims 6, 12, and 18 over Kim, Sorrells, and Tanaka, and further in view of a patent application publication by Senarath, et al., U.S. Patent App. Pub. No. 2008/0076432 ("Senarath") (DISH-1025). *Id.*, 120-122.

57. Kim is directed to a mobile communication system. DISH-1022, Abstract. Kim describes methods and systems for a mobile device "to synchronize a time

and a frequency and search a cell by using a pilot structure suitable for a downlink" in networks that use orthogonal frequency division multiple access (OFDMA). *Id.*, [0002].

58. Sorrells is directed to "frequency translation" in wireless local area network (WLAN) applications such as those that use the IEEE 802.11 standard. DISH-1023, Abstract. Sorrells discloses numerous frequency translations and applications, including, "frequency down-conversion, frequency up-conversion, enhanced signal reception, unified down-conversion and filtering," and others. *Id.*, 2:7-12.

59. In the first Office Action, with respect to independent claim 1 and other independent claims, the Examiner found that Kim discloses a method for communications using OFDMA in a network with a plurality of transmitting network devices having a set of available OFDMA subcarriers, allocating a subset of the available subcarriers to each of the transmitting network devices, and a transmitting network device mapping a packet onto a plurality of modulated symbols to be transmitted on used subcarriers of its allocated subset of available subcarriers. DISH-1005 at 106-107 (and more generally 106-114). The Examiner's rejection also explained that Kim discloses the use of a pseudorandom sequence. *Id.*, 106-107 (citing DISH-1005 at [0065], [0072]).

60. The Examiner also found that Kim "does not specifically teach . . . a transmitting network device . . . mapping the packet onto a plurality of quadrature amplitude modulated symbols to be transmitted on the used subcarriers" and "the transmitting network device performing a predetermined transformation on a quadrature amplitude modulated symbol using the element of the pseudorandom noise sequence corresponding to the used subcarrier." DISH-1005 at 107. However, the Examiner found that Sorrells discloses mapping the packet onto a plurality of quadrature amplitude modulated symbols. *Id.*, 107-108 (and more generally 106-114).

61. The Applicant responded to the first Office Action on February 8, 2012. DISH-1005 at 87-97. The Applicant responded by traversing the rejections under § 103 over Kim and Sorrells, and did not amend any claims.

62. Specifically, the Applicant argued Kim's use of a pseudorandom sequence "has nothing to do with a 'transmitting network device performing a predetermined transformation on a quadrature amplitude modulated symbol using the element of the pseudorandom noise sequence corresponding to the used subcarrier'." DISH-1005 at 95. According to Applicant, Kim uses a pseudorandom sequence to determine "how to place particular pilot subcarriers within a set of subcarriers, where each cell within a cellular communications network will be identified by the particular set of pilot subcarriers that it is transmitting," rather than to "scramble

the symbols to be transmitted" as purportedly recited by independent claim 1. *Id.* The Applicant also argued that Sorrells, Tanaka, and Senarath failed to disclose this limitation of independent claim 1 and other independent claims.

63. Following the Applicant's response, the Examiner issued a Final Office Action on April 26, 2012. DISH-1005 at 79-84.

64. In the Final Office Action, the Examiner withdrew the rejections of claims 1-18 under § 103 but maintained the rejections of claims 16-18 under § 101. *Id.* In maintaining the rejections under § 101, the Examiner "suggest[ed] to replace the 'computer readable medium' recited in claims 16-18 with 'non-transitory computer readable medium'." *Id.*, 82. According to the Examiner, such an amendment would overcome the § 101 rejection because it would avoid "the limitation/term [being] broadly interpreted to include, non-statutory subject matter such as signal or carrier waves." *Id.*

65. The Applicant responded to the Final Office Action on June 20, 2012 by amending independent claim 16 to recite a "non-transitory computer readable medium" as suggested by the Examiner. DISH-1005 at 58-77.

66. The Examiner subsequently allowed all of claims 1-18 on July 24, 2012, with the '566 patent ultimately issuing on November 27, 2012. DISH-1005 at 17, 25-29; DISH-1001 (Face of Patent).

67. On 2009-10-15, Applicant filed an application, with eighteen claims, that would issue as the '566 patent. DISH-1005 at 159, 190-96. The original claims issued without substantive amendment.

C. Level of Ordinary Skill in the Art

68. Based on the foregoing and upon my experience in this area, a person of ordinary skill in the art ("POSITA") relating to the subject matter of the '566 patent as of October 16, 2008 would have a degree in electrical engineering, computer engineering, or a related field and experience working in signal processing and/or communication systems/networks, e.g., a bachelor's and three or more years of experience; a master's and at least one year of experience; or a doctorate and some work experience. Additional education could substitute for professional experience, or *vice versa.*

69. For at least the reasons I explained in the sections about my qualifications, I would consider myself to have qualified as a POSITA as of the earliest possible priority date for the '566 patent of October 16, 2008.

VI. GROUND 1A – CLEVELAND IN VIEW OF HAYASHINO

A. Cleveland Overview (DISH-1006)

70. Cleveland is directed a wireless network that uses OFDMA. DISH-1006 (Abstract). Specifically, Cleveland is directed to allocating bandwidth in a WiMAX network, which is one type of network that uses OFDMA. *Id.*, ¶¶ 5, 81

(Cleveland's "disclosure may be used in any suitable wireless communication system."). Thus, Cleveland describes an exemplary OFDMA network having multiple base stations (red) and multiple subscriber stations (blue):

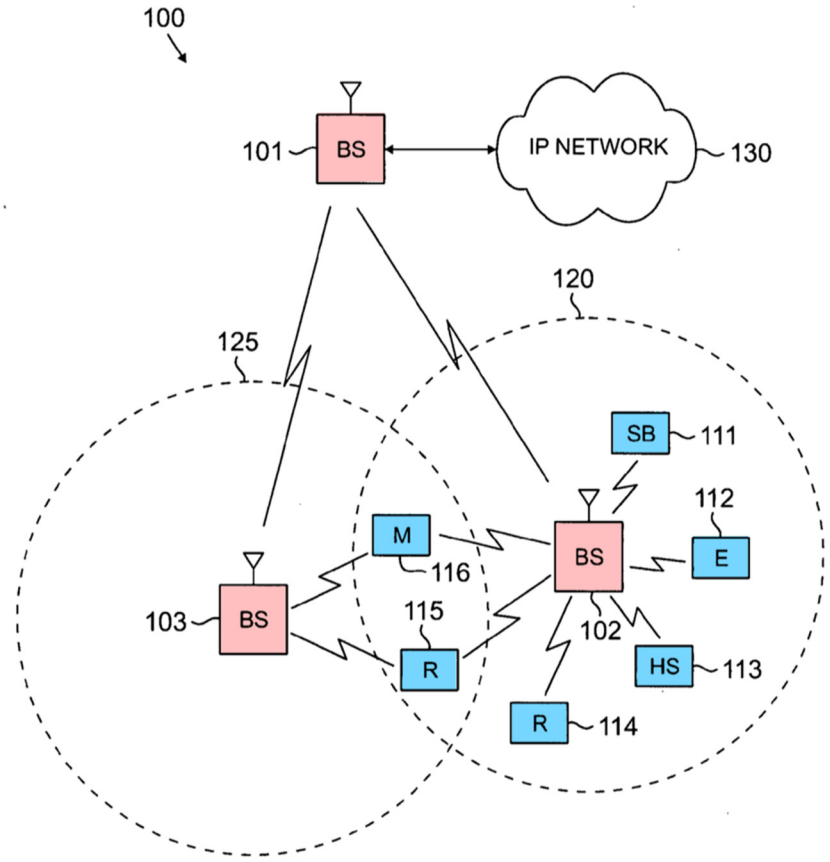


FIG. 1

FIGURE 1 OF CLEVELAND

DISH-1006 at ¶¶ 25-35. Cleveland's subscriber stations can be any mobile device, e.g., a "laptop [or] handheld device." DISH-1006 at ¶¶ 27, 31.

71. Cleveland uses typical OFDMA equipment, in connection with particular bandwidth-allocation techniques. See Abstract, ¶¶ 36-38 (disclosing conventional

equipment), ¶¶ 7-9 (describing techniques). In this respect, Cleveland Figure 2 depicts a typical OFDMA transmitter, and Figure 3 depicts a typical OFDMA receiver:

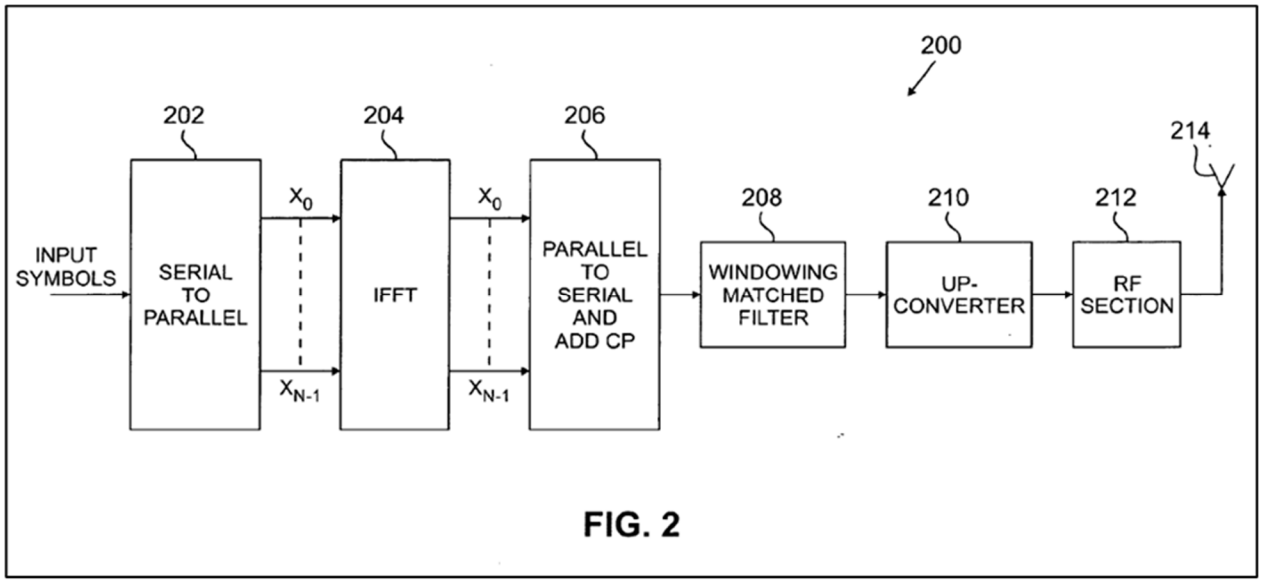


FIG. 2

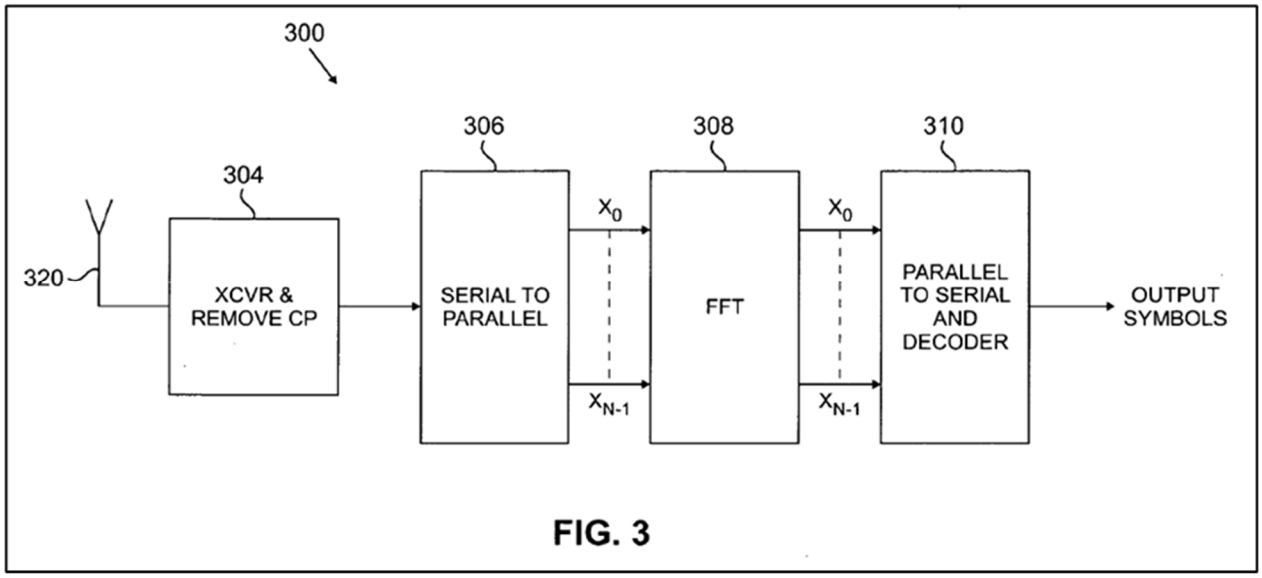


FIG. 3

FIGURES 2 AND 3 OF CLEVELAND

72. Thus, with respect to the challenged claims, Cleveland represents a known OFDMA network.

73. I note that although Cleveland describes the features of base stations, subscriber stations (e.g., cell phones), transmitters, and receivers, it does not explicitly state that each such station has a transmitter and a receiver. See DISH-1006, ¶¶25-40. However, a POSITA would have understood that each base station and each subscriber station includes both a transmitter and a receiver so that they can communicate with each other.

74. As Cleveland acknowledges, known OFDMA systems suffered from intercell interference. Cleveland aims to address this problem by selecting subcarriers with a pseudorandom sub-channel assignment algorithm. DISH-1006 at ¶¶ 42-45.

75. Cleveland's sub-channel assignment algorithm works by drawing a subcarrier (e.g., 504a and 504b from FIG. 5A represent discrete subcarrier frequency bands) from a permutation group (502), which is a group of subcarriers. DISH-1006, ¶¶42-43, FIG. 5A.

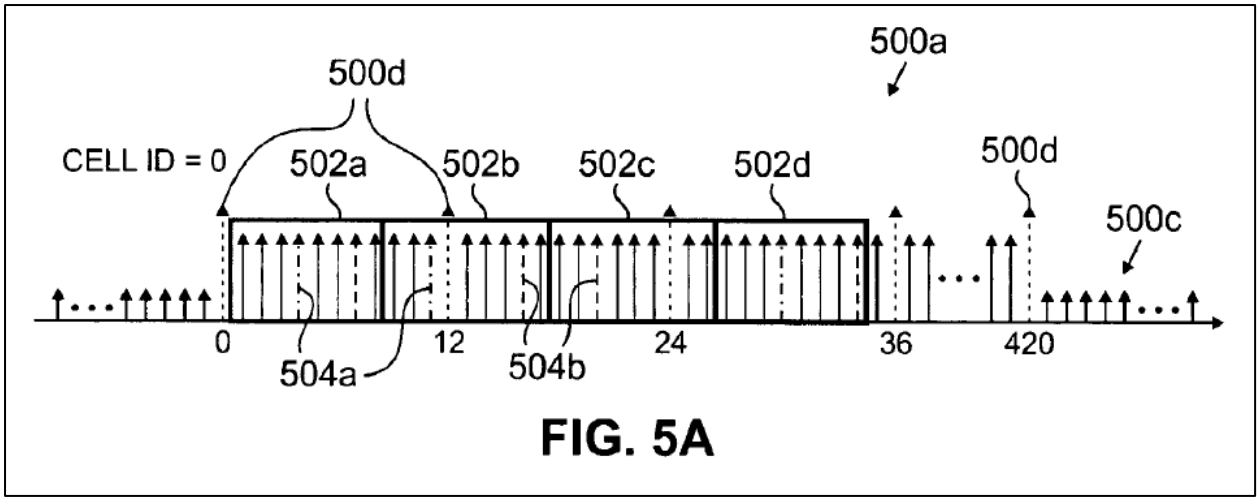


FIGURE 5A OF CLEVELAND

76. In Cleveland, the subcarrier draw is "pseudorandom . . . so that there is a high probability that the sub-carriers for a given sub-channel in a certain cell are different than sub-carriers for that same sub-channel in another cell." *Id.* The drawn subcarrier is then used in a new subchannel. *Id.* Cleveland process is advantageous, as a POSITA would appreciate: "[t]his pseudorandom permutation provides an interference averaging effect further reducing the adverse effects of cell to cell interference." *Id.*

B. Hayashino Overview (DISH-1007)

77. Hayashino discloses "an [OFDM] . . . method of transmitting data between a transmission side and a receiving side through a wire or wireless transmission path." DISH-1007 at 1:7-12. Hayashino's "OFDM transmission system is adapted to divide coded data and sort the same into at least hundreds of carriers, for multiplexing and transmitting." DISH-1007 at 1:17-20. Referring to Figure 13

(below), Hayashino's Input Symbol Train is modulated by "conventional" OFDM transmitters using "16 QAM." DISH-1007 at 1:38-55.

FIG. 13

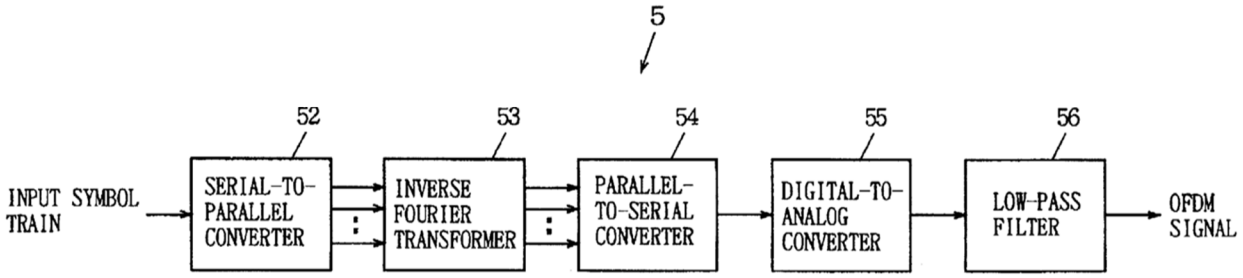


FIGURE 13 OF HAYASHINO

78. A problem arises when "transmitting a sounding state or a multicolor picture [because] the carrier modulation signals tend to be completely in phase with each other in a digital modulation system such as . . . 16 QAM." DISH-1007 at 2:54-64. This scenario results in carrier nodes "concentrated to one portion on the time axis. . . caus[ing] power concentration." *Id.*, 2:65-3:5. To address this problem, Hayashino introduces pseudorandom noise to vary carrier phase using the OFDM transmitter shown below (Figure 9).

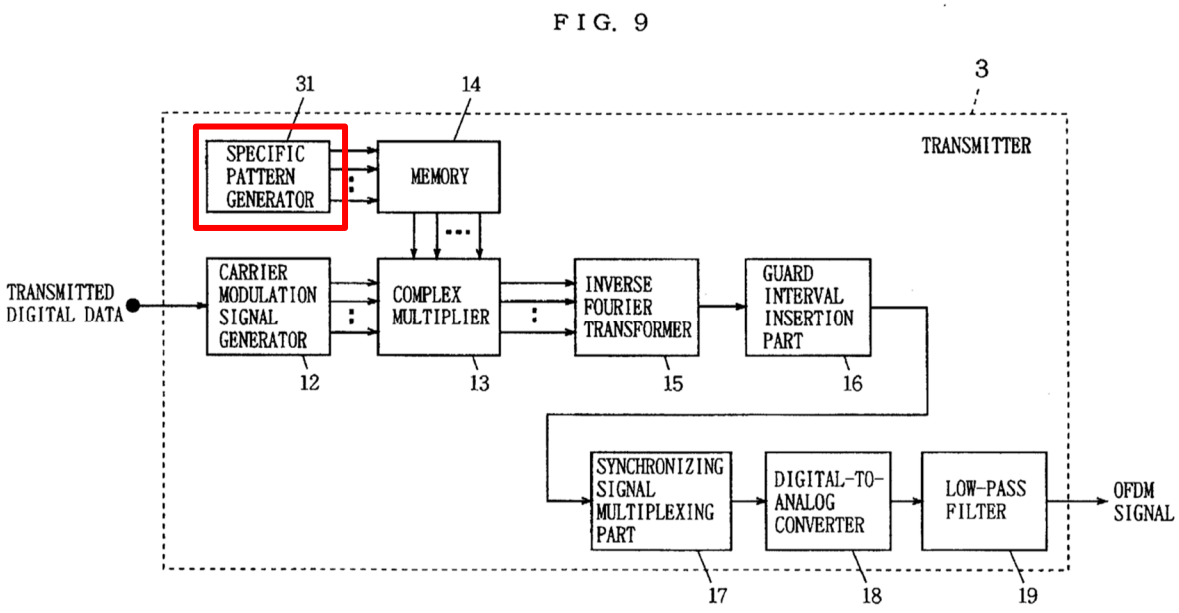


FIGURE 9 OF HAYASHINO

79. Figure 9 features "specific pattern generator 31" which outputs "complex signal group DO having a predetermined specific pattern with signals which mutually vary in phase at random." DISH-1007 at 12:22-31. The complex signal group "can be formed by a pseudo-noise signal generator comprising a PN series pseudo-random signal generator for generating a pseudo-random signal . . . randomizing mutual phases of respective carrier modulation signals." DISH-1007 at 12:31-48. Hayashino teaches that "16 QAM" is utilized as the modulation scheme and that reference "values in the range of zero to 2π" are applied. DISH-1007 at 12:50-54, 13:18-22. The result of this operation is that "the OFDM signal . . . can be suppressed from power concentration" making it unnecessary to

"increase the dynamic ranges of the transmitter." DISH-1007 at 13:20-25, 14:7-18.

C. Combination of Cleveland and Hayashino

80. It is my opinion that a POSITA would have been motivated to modify Cleveland's system to incorporate Hayashino's teachings, which a POSITA would have recognized would improve Cleveland's system.

81. Cleveland-Hayashino uses Hayashino's pseudorandom-noise-sequence techniques on Cleveland's OFDMA equipment, resulting in an OFDMA network with lowered interference and eliminating the need for more expensive OFDMA equipment with a larger dynamic range. Lowering the interference reduces the power concentration, which in turn reduces the peak-to-average power ratio ("PAR") and the dynamic range required by the OFDMA equipment.

82. Both Cleveland and Hayashino utilize orthogonal-frequency-division data-transmission techniques in communication networks. *Compare* DISH-1006 (Abstract) ("A system and method for synchronous spectrum sharing for use in a wireless communication system based on . . . OFDM or . . . OFDMA signaling is disclosed.") *with* DISH-1007 at 1:7-9 ("The present invention relates to an . . . OFDM transmission method.").

83. Moreover, both Cleveland and Hayashino are directed to reducing interference in OFDM-based networks. DISH-1006 at ¶¶ 37, 42, 45; DISH-1007 at 2:51-3:5, 13:7-22.

84. Additionally, Hayashino teaches that using its pseudorandom technique avoids the need to increase the transmitter's range, which allows engineers (e.g., a POSITA) to use lower-priced equipment. DISH-1007 at 13:23-26.

85. Further, it is my opinion that Cleveland and Hayashino are from the same field of endeavor, multiplex communication in networks using orthogonal techniques. Additionally, both references are reasonably pertinent to the problems that the '566 patent's inventors faced, e.g., interference in OFDM/OFDMA systems. DISH-1001 at 1:17-20; DISH-1006 at ¶ 45; DISH-1007 at 2:65-3:23.

86. A POSITA seeking to improve on Cleveland's base OFDMA system would have looked to a reference such as Hayashino, which teaches methods to reduce power concentration, and thus ameliorates multi-device interference. Similarly, a POSITA looking to simplify Cleveland's pseudorandom sub-channel assignment algorithm would have realized the benefits of using Hayashino's approach in lieu of selecting each sub-channel in a pseudorandom manner, as Cleveland does. This would have resulted in Cleveland's network introducing a pseudorandom element on each used subcarrier as Hayashino teaches, thus simplifying the process of determining which subchannels have been used and which are available for

transmission. Thus, a POSITA seeking to reduce the interference reported in an OFDMA network, like Cleveland's, would have looked at other references, such as Hayashino, that describe OFDM/OFDMA networks and reduce interference.

87. For example, Hayashino explains that using conventional OFDM data transmission techniques applied to signals lacking phase diversity resulted in carriers "concentrated to one portion on the time axis . . . caus[ing] power concentration." 2:51-3:5, FIG. 15. Hayashino teaches that introducing pseudo-random signals into the phase modulation process provides a more-uniform waveform, thereby suppressing the "power concentration." *Id.*, 13:8-22. A POSITA would have understood that power concentration suppression or averaging refers to a reduction in peak-to-average ratio ("PAR").[3]

88. Further, a POSITA would have understood that the reduction in PAR resulting from Hayashino's methodology for introducing pseudo-random signals into the phase modulation process yields numerous benefits. For example, consistent with Hayashino's teachings, a POSITA would realize that reducing PAR is beneficial because it lessens signal interference, which allows engineers (e.g., a POSITA) to use lower-power and cheaper transmitters. DISH-1007 at 3:24-35; 13:22-30. This improvement by itself would have benefited Cleveland.

[3] PAR, in plain English, refers to how strong the signal is compared to background noise.

89. Further, a POSITA would have appreciated that because a reduction in PAR conserves power, it permits using lower-power transmitters/receivers to maintain the current range or other system characteristics. A POSITA would have readily realized this improvement's benefit, particularly with respect to the wireless networks that Cleveland discloses. DISH-1006 at ¶ 31 (explaining a laptop can be a network device), ¶ 73 (describing a network of "battery-powered secondary nodes").

90. Further, a POSITA would have found implementing Hayashino's method in Cleveland's system a predictable and routine exercise. For example, both Cleveland and Hayashino discuss mapping parallel data streams into serial orthogonal phase (I or real) and quadrature (Q or imaginary) components. Cleveland utilizes "serial-to-parallel converter 202 [to] map[] each parallel data stream into I and Q modulation symbols." DISH-1006 at ¶ 36. Hayashino likewise incorporates 16 QAM in conjunction with complex multiplier 13 to diversify the serialized phase (real) and quadrature (imaginary) modulation symbols. DISH-1007 at 12:49-13:6, FIG. 10. To accomplish this, Hayashino also utilizes "parallel-to-serial converter 54 . . . converts the multiplex signal on the time axis, thereby forming a OFDM signal." DISH-1007 at 2:7-9.

91. The efficiencies as well as the similarities across Cleveland and Hayashino's teachings, would have led a POSITA to incorporate Hayashino's OFDM

transmitter's pseudo-random noise circuitry (and its associated operation) into Cleveland's existing OFDM transmitter, as illustrated in one exemplary implementation (below). DISH-1006 at FIG. 2; DISH-1007 at FIG. 9.

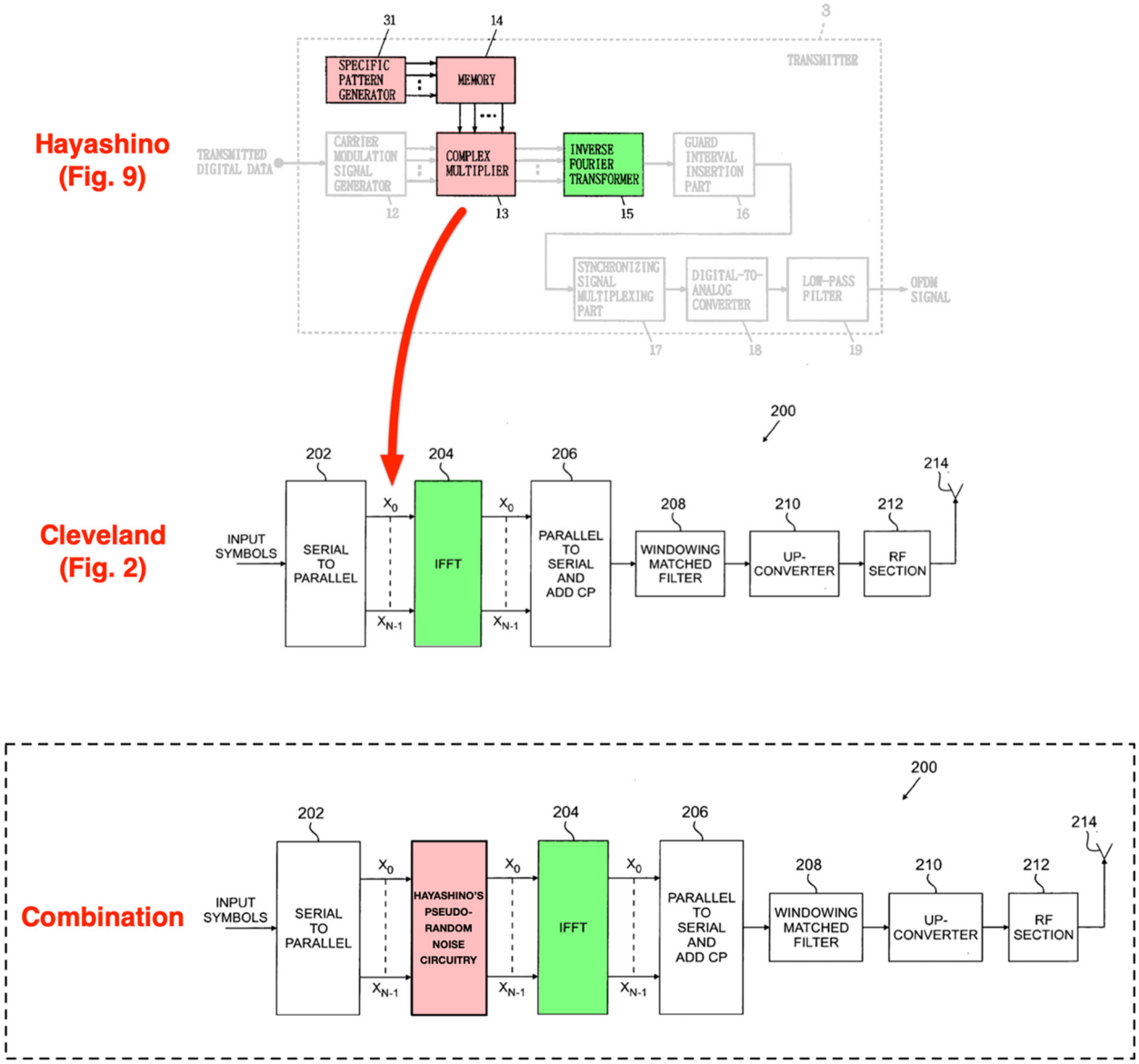


FIGURE 9 OF HAYASHINO; FIGURE 2 OF CLEVELAND; COMBINATION

92. A POSITA would have had a reasonable expectation that the Cleveland-Hayashino combination would have had a foreseeable chance of success.

Incorporating such circuitry is predictable, routine engineering and is well within a POSITA's abilities.

93. Further, as shown above, utilizing Hayashino's pseudorandom noise circuitry in Cleveland would not change Cleveland's principle of operation or require a substantial redesign of its elements. Indeed, Hayashino contemplates that "the reference complex signal group may alternatively be directly inputted in the inverse Fourier transformer 15" such as Cleveland's IFFT block (204). DISH-1007 at 14:1-6. Thus, a POSITA would have reasonably expected that applying Hayashino in Cleveland would reduce PAR, as Hayashino teaches.

94. In sum, a POSITA would have been motivated to reduce PAR in communications systems to reduce signal interference and to utilize lower-power and less-costly transmitters, and a POSITA would have reasonably expected that applying Hayashino's teachings in an OFDMA system like Cleveland's would lower PAR because applying Hayashino represents using concepts from a known technique/system to improve a similar system, namely Cleveland.

D. Claim 1

1. Preamble

[1pre] "A method for communications transmission using orthogonal frequency division multiple access on a network comprising:"

95. I have been asked to consider whether the combination of Cleveland and Hayashino discloses or renders obvious the preamble of claim 1, but I have not been asked to render an opinion on whether the preamble should be considered a limitation. If the preamble of claim 1 is deemed to be a limitation, it is my opinion that Cleveland discloses [1pre], or renders it obvious in view of Hayashino.

96. Cleveland discloses "[a] system and method for synchronous spectrum sharing for use in a wireless communication system based on orthogonal frequency-division multiplexing (OFDM) or orthogonal frequency division multiple access (OFDMA) signaling." DISH-1006 (Abstract).

97. Hayashino similarly discloses "an orthogonal frequency division multiplexing (hereinafter referred to as OFDM) transmission method . . . of transmitting data [(communications transmission)] between a transmission side and a receiving side through a wire or wireless transmission path with an orthogonal frequency division multiplex signal." DISH-1007 at 1:7-13.

98. A POSITA would have also understood that Hayashino's OFDM concepts were applicable to Cleveland's OFDM/OFDMA systems. For example, Cleveland clarifies that its concepts can be used in OFDM and OFDMA systems and that contemporary networks use "OFDM and/or OFDMA techniques." DISH-1007 at 1:7-13; DISH-1006 (Abstract), ¶ 29, 36, 40, FIG. 2.

2. Element 1a

[1a] "a) providing a plurality of transmitting network devices with a set of available subcarriers for orthogonal frequency division multiple access"

99. It is my opinion that Cleveland discloses 1a, and that Cleveland-Hayashino renders this element obvious.

100. Cleveland's base stations and subscriber stations are "transmitting network devices" with a set of "available subcarriers" for OFDMA use in a wireless network.

101. Cleveland discloses "[a] system and method for synchronous spectrum sharing for use in a wireless communication system based on orthogonal frequency-division multiplexing (OFDM) or orthogonal frequency division multiple access (OFDMA)." DISH-1006 (Abstract). Figure 1 depicts a "plurality of transmitting network devices" in wireless network 100, which "includes base station (BS) 101, base station (BS) 102, and base station (BS) 103." BS 102 and 103 "communicate . . . with subscriber stations 111-116 using OFDM and/or OFDMA techniques." DISH-1006 at ¶¶ 25, 27-29, FIG. 1.

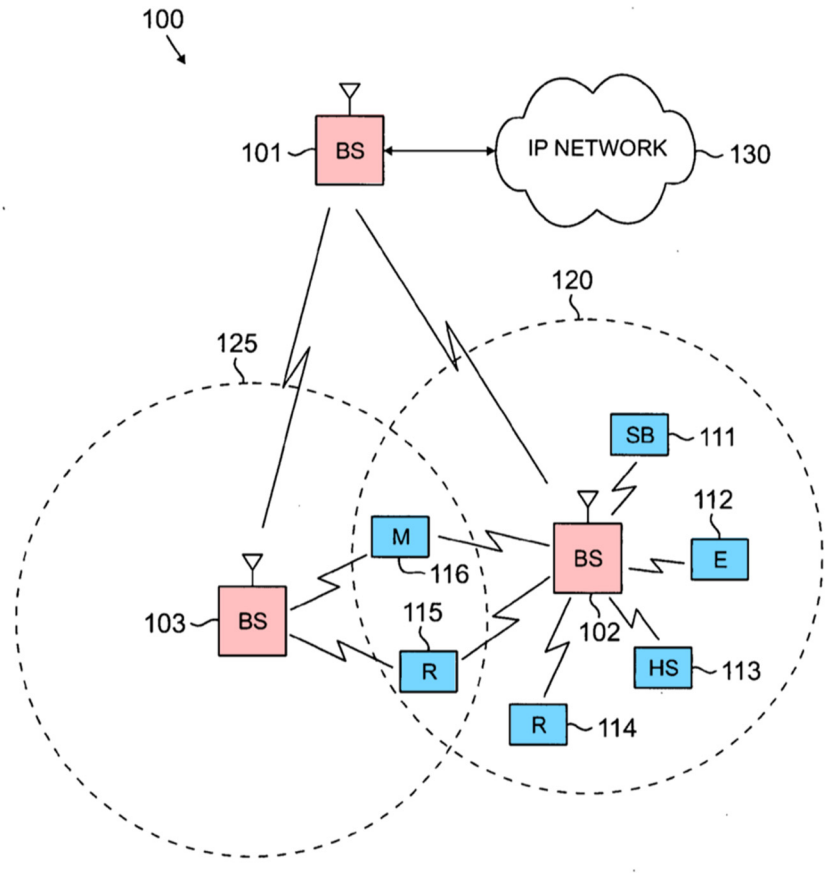


FIG. 1
FIGURE 1 OF CLEVELAND

102. Additionally, subscriber stations 111-116 also qualify as a plurality of transmitting devices. In Cleveland, as in many communications systems, both the base station and subscriber stations each transmit and receive data. This makes sense—as an example, consider a cell phone network, where base stations and cell phones each transmit and receive data to facilitate a conversation.

103. Spectrum sharing—here, assigning subcarriers for OFDMA—in Cleveland "includes a primary user node and a secondary user node" wherein "[t]he

secondary user node transmits data in a first one of usable sub-carriers identified in the subframe information." DISH-1006 at [0007]. In Cleveland, a "primary user node" simply means the nodes has priority access to spectrum. DISH-1006 at ¶¶55-56 ("The term "secondary user" generally refers to a spectrum user who is not an owner of the spectrum but who operates in the spectrum based on agreements/etiquettes imposed by the primary users or regulatory entities.").

104. As shown below in Figure 5A, Cleveland teaches that "sub-carrier allocation[] 500a" is achieved through "a permutation process [that] draws a sub-carrier pseudo-randomly from permutation groups 502 [(e.g., 502a, 502b, 502c, 502d)] . . . so that there is a high probability that the sub-carriers for a given sub-channel in a certain cell are different than sub-carriers for that same sub-channel in another cell." *Id.*, [0041-43].

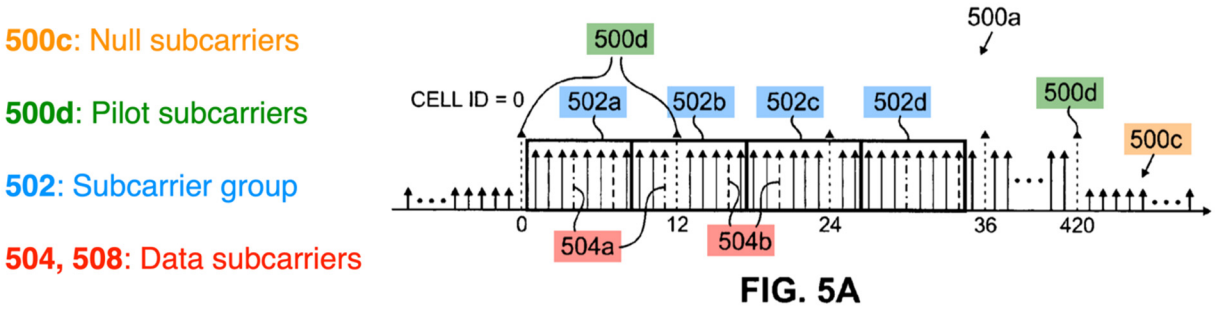


FIG. 5A

FIGURE 5A OF CLEVELAND

105. With respect to Figure 5A, a POSITA would have understood that the depicted subcarriers are available for use by the plurality of transmitter devices (and not just a subset of devices).

106. Hayashino also discloses a transmitter, albeit for OFDM. Specifically, Hayashino discloses a transmitting network device in its network. DISH-1007, 3:39-55, FIG. 1. This further shows that Cleveland-Hayashino renders obvious providing a plurality of transmitting network devices with subcarrier for OFDMA.

3. Element 1b

> [1b] "b) providing a corresponding element of a pseudorandom noise sequence for each subcarrier of the set of available subcarriers"

107. It is my opinion that Hayashino discloses 1b, and that Cleveland-Hayashino renders this element obvious.

108. Cleveland-Hayashino renders obvious 1b through Hayashino's introduction of pseudo-random sequences to vary carrier signal phase. DISH-1007 at 12:27-48, FIG. 9.

109. Hayashino's transmitter includes a "memory 14 [that] holds an output of a specific pattern generator 31, i.e., a complex signal group DO having a predetermined specific pattern with signals which mutually vary in phase at random" wherein "complex signal group DO can be formed by a pseudo-noise signal generator comprising a PN series pseudo-random signal generator." DISH-1007 at 12:27-35.

FIG. 9

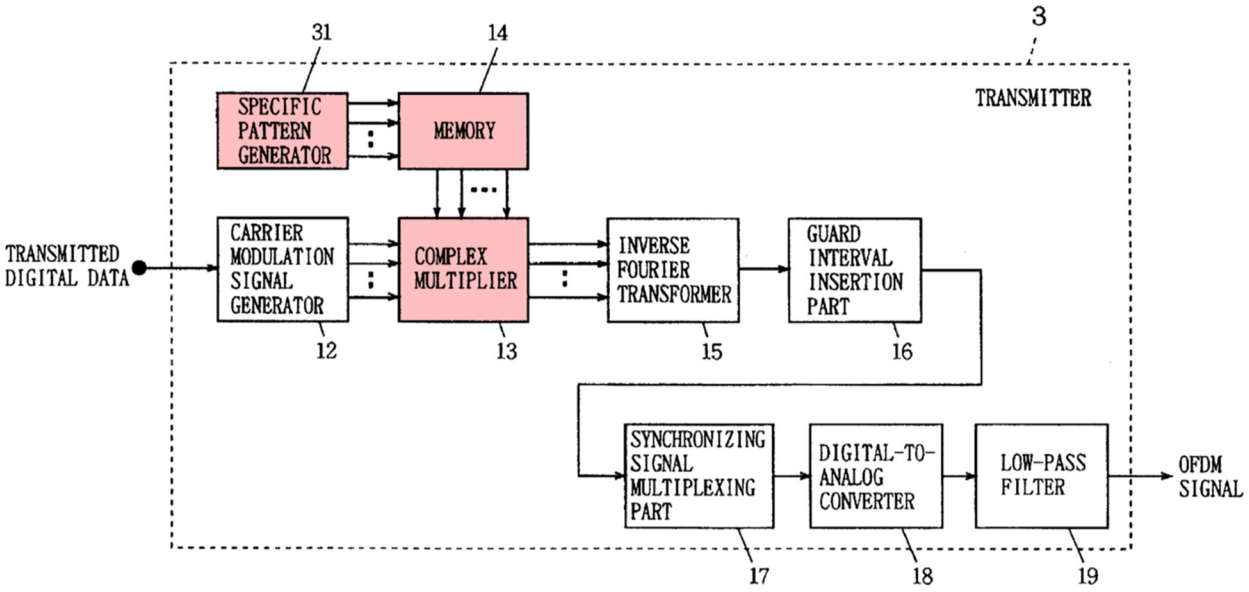


FIGURE 9 OF HAYASHINO

110. In the transmitter, "complex multiplier 13 complex-multiplies data Dm of each symbol interval by data D_0 on the frequency axis every time data Dm is inputted for forming data D'_m ($D'_m = D_m \times D_0$), thereby randomizing mutual phases of respective carrier modulation signals included in a carrier modulation signal group to specific patterns" as illustrated in Figure 11. *Id.*, 12:43-46, 13:8-12, FIG. 11.

FIG. 11

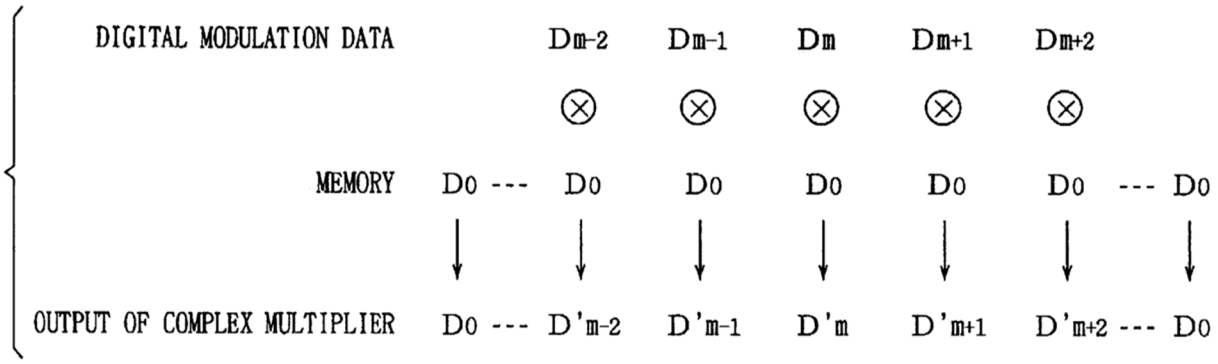


FIGURE 11 OF HAYASHINO

111. With respect to 1b, a POSITA would have understood that output D_0 is a "corresponding element of a pseudorandom noise sequence" and that D_m represents an "available subcarrier."

112. To be clear, I note that although Hayashino does not use the words "available subcarrier," a POSITA would have understood that Hayashino's reference "to respective carriers" means a subcarrier, particularly within an OFDM context.

113. Because D_0 is provided for each D_m, Hayashino also provides the corresponding element of the PN sequence "for each subcarrier" used. *Id.*

114. Hayashino teaches that its method of randomizing carrier phase reduces interference and "power concentration" in the OFDM signal output from inverse Fourier transformer 15. DISH-1007 at 3:14-36, 13:18-25, 14:7-18, FIGS. 9, 15. A POSITA reading Hayashino would have understood that this refers to reducing

signal PAR, which is desirable for the reasons noted above. See § VI.C (Combination of Cleveland and Hayashino).

115. References teaching the benefits of reducing PAR are commonplace. For example:

- Fazel notes that one of the disadvantages of OFDM-based multi-carrier modulation is a high . . . [Peak to Average Power Ratio ("PAPR")][4] requir[ing] high linear amplifiers." DISH-1008 at 34.
- Tzannes observes that "[i]f the phase of the modulated carriers is not random, then the PAR can increase greatly." DISH-1009 at 2:10-11.
- Nanba also teaches that when subcarrier phases in an OFDM signal are aligned the "waveform . . . PAPR (Peak to Average Power Ratio) is large, and the amplifier is burdened." DISH-1010 at 5.
- Moffat explains that "[b]ecause the OFDM signal is the sum of a large number of subcarrier signals, it can have a high peak-to-average amplitude or power ratio." DISH-1011 at ¶ 4.

116. A POSITA would have been motivated to incorporate the pseudo-random noise circuitry of Hayashino's transmitter into Cleveland's transmitter for the

[4] "PAPR" is "peak to average power ratio," which is synonymous with PAR. DISH-1009 at 49.

reasons discussed above. See § VI.C (Combination of Cleveland and Hayashino).

The Cleveland-Hayashino transmitter is depicted below:

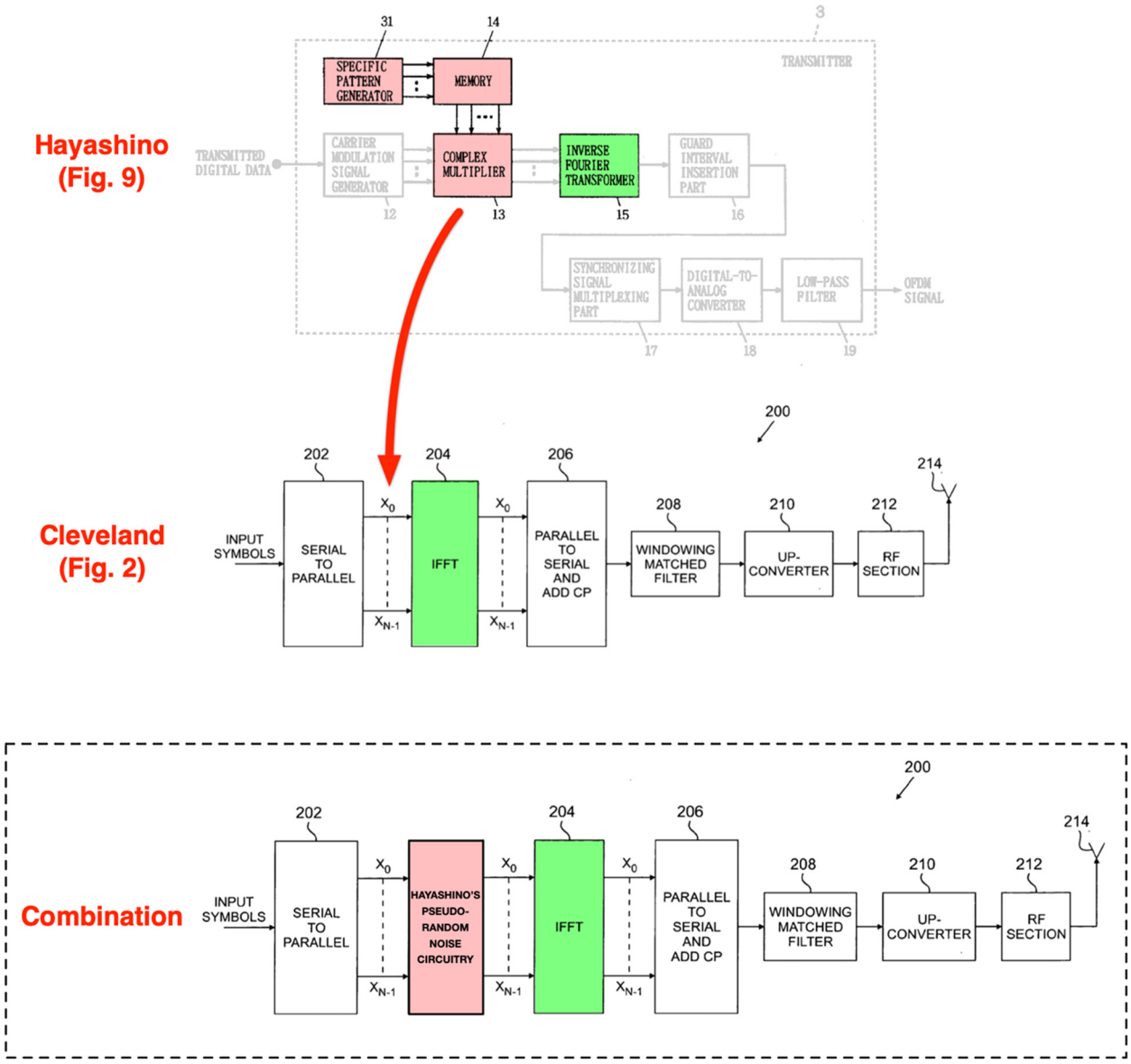


FIGURE 9 OF HAYASHINO; FIGURE 2 OF CLEVELAND; COMBINATION

117. In the Cleveland-Hayashino combined system, the data signals of parallel data stream x_0 through x_{n-1} are multiplied using Hayashino's pseudo-random noise circuitry before undergoing the inverse fast Fourier transform (IFFT) of

Cleveland's block 204. This process would have acheived the results of Hayashino's pseudo-random noise circuitry described above in the Cleveland transmitter.

118. The Cleveland-Hayashino transmitter would have rendered obvious element 1b because Hayashino's pseudorandom noise circuitry (31, 14, and 13) provides an element of a pseudorandom noise sequence to each subcarrier used in the OFDMA scheme.

4. Element 1c

[1c] "c) allocating a subset of the set of available subcarriers to each of the transmitting network devices"

119. It is my opinion that Cleveland discloses 1c, and that Cleveland-Hayashino renders this element obvious.

120. As an initial matter, a POSITA would have understood that OFDMA systems allocate a subset of available subcarriers to transmitting devices. For example, the Fazel textbook explains that an OFDMA system "consists of assigning one or several sub-carrier frequencies to each user (terminal station) with the constraint that the sub-carrier spacing is equal to the OFDM frequency spacing 1/Ts." DISH-1008 (Fazel) at 118. Element 1c is merely describing how an OFDMA system works—most, if not all, OFDMA systems disclose or include this element.

121. Cleveland, which is an OFDMA system, uses pseudo-random subcarrier allocation techniques to allocate subcarriers to secondary user nodes ("SU") in a communications network. DISH-1006 (Abstract), ¶¶ 4-5, 41-44.

122. In Cleveland, a secondary user node "refers to a spectrum user who is not an owner of the spectrum but who operates in the spectrum based on agreements/etiquettes imposed by the primary users or regulatory entities." DISH-1006 at ¶ 55. Cleveland's pseudo-random subcarrier allocation technique thus discloses "allocating a subset of the set of available subcarriers to each of the transmitting network devices."

123. In the Cleveland and Hayashino combination, Cleveland's network would apply Hayashino's scrambling technique to each subcarrier that is available for use (as discussed under elements 1b and 1d). Cleveland uses broadcast frames that contain information about which sub-channels are "usable sub-channels." DISH-1006 at ¶ 52. Cleveland's secondary users have dynamic access to various sub-carriers. DISH-1006 at ¶¶ 55-57 ("The available spectrum and/or sub-carriers for use by the secondary users are time varying and location-dependent because of the traffic load and distribution of the primary users."). Within this system, "SU [secondary unit] MAP 636 identifies those sub-carriers that are usable by secondary users." DISH-1006 at ¶¶ 55-57 and ¶¶ 69-70 (Cleveland's secondary

nodes uses an OFDM/OFDMA broadcast frame ultimately to "ascertain which set[s] of sub-carriers" are available.).

124. A POSITA would have understood that "MAP" in Cleveland refers to the uplink application map or downlink allocation map, depending on whether the message is transmitted or received.

5. Element 1d

> [1d] "d) [i] a transmitting network device of the plurality of devices [ii] mapping a packet onto a plurality of used subcarriers of its allocated subset of available subcarriers, wherein the step of mapping the packet comprises [iii] mapping the packet onto a plurality of quadrature amplitude modulated symbols to be transmitted on the used subcarriers"

125. It is my opinion that Cleveland and Hayashino each disclose 1d, and that Cleveland-Hayashino renders this element obvious.

126. With respect to element 1d, a POSITA would also have understood that "quadrature amplitude modulated symbols" refers to PHY data that is "modulated onto a plurality of frequency subcarriers . . . using quadrature amplitude modulation (QAM)" where "[t]he two subcarriers are termed the quadrature (Q) component and the in phase (I) component." DISH-1001 at 4:8-21, FIG. 2 (reproduced below).

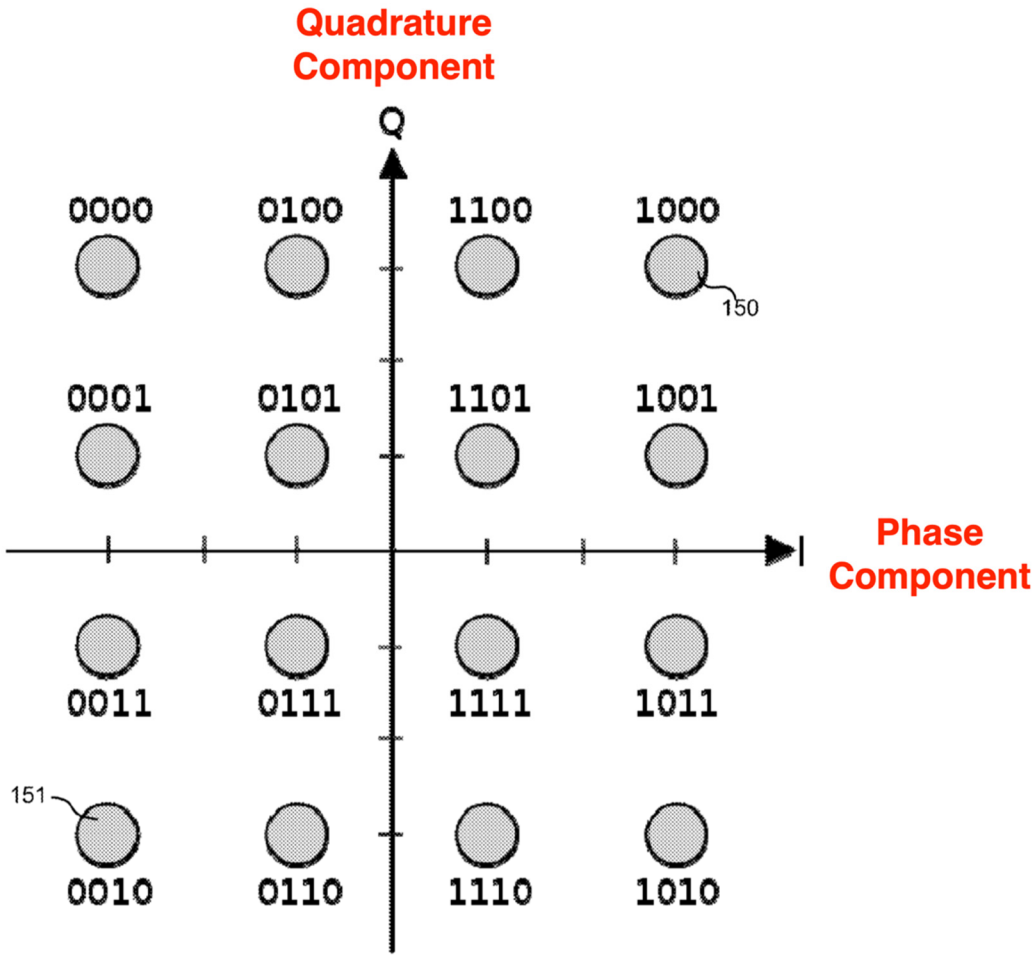


Fig. 2

FIGURE 2 OF '566 PATENT

127. Referring to Figure 4 (reproduced below), the '566 patent discloses that "[i]nput bit stream 250 may represent a PHY packet" and "coding module 249 transforms the serial bit stream to a parallel stream using serial-to-parallel module 251" which "is then presented to a QAM module 252." DISH-1001 at 5:59-66, FIG. 4.

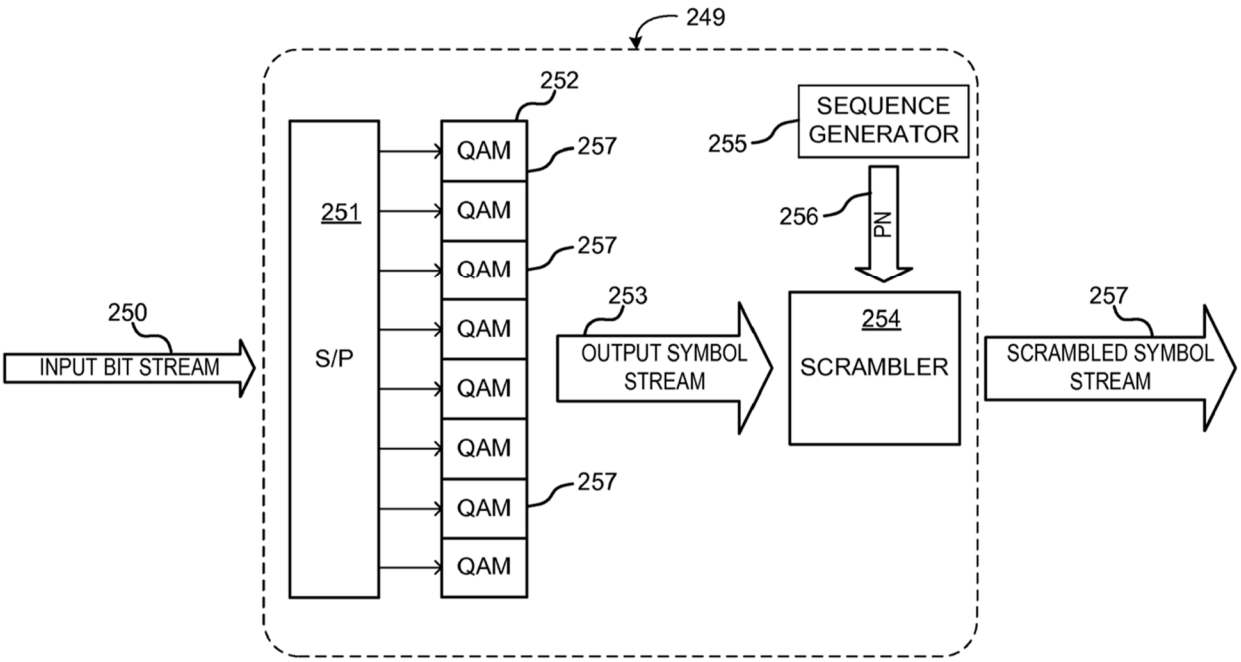


Fig. 4

FIGURE 4 OF '566 PATENT

Thus, the '566 patent maps PHY packets using QAM.

128. For subpart [1d.i], Cleveland's OFDM/OFDMA transmitter (200) is a transmitter in each "transmitting network device." DISH-1006 at ¶ 36.[5] This transmitter would be present in each base station and remote device in the network.

129. For subpart [1d.ii], Cleveland's transmitters, map "a packet onto a plurality of used subcarriers of its allocated subset of available subcarriers." Cleveland

[5] Although a single transmitter is discussed, it is understood the discussion applies to multiple transmitters.

maps packets onto subcarriers with a mapping function in a serial-to-parallel converter 202. See DISH-1006 at ¶¶ 36, 62.

130. For subpart [1d.iii], Cleveland maps PHY packets using QAM symbols. See DISH-1006 at ¶¶ 36, 62. Specifically, Cleveland discloses a "WIMAX OFDMA physical layer (PHY)" that "supports sub-channelization in both the up-link (UL) and the down-link (DL)" utilizing "diversity permutation [that] draws sub-carriers pseudo-randomly to form a sub-channel." DISH-1006 at ¶ 45. Cleveland teaches that "a typical OFDM/OFDMA transmitter . . . constructs . . . an OFDM/OFDMA composite signal by first passing the serial output of a formatted, encoded, interleaved data signal through serial-to-parallel converter 202[, that] separates each data signal into parallel data streams." *Id.*, ¶¶ 36, 62, FIG. 2. Then, a "mapping function (MAP) within serial-to-parallel converter 202 maps each parallel data stream into I and Q modulation symbols, which are then applied to inverse fast Fourier transform (IFFT) block 204." *Id.* Cleveland Figure 2 and the exemplary combination with Hayashino are shown below.

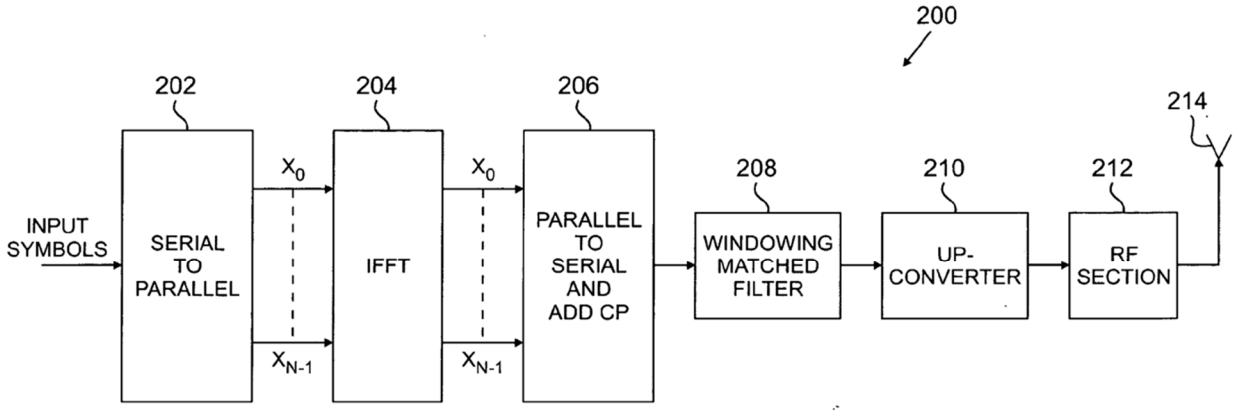
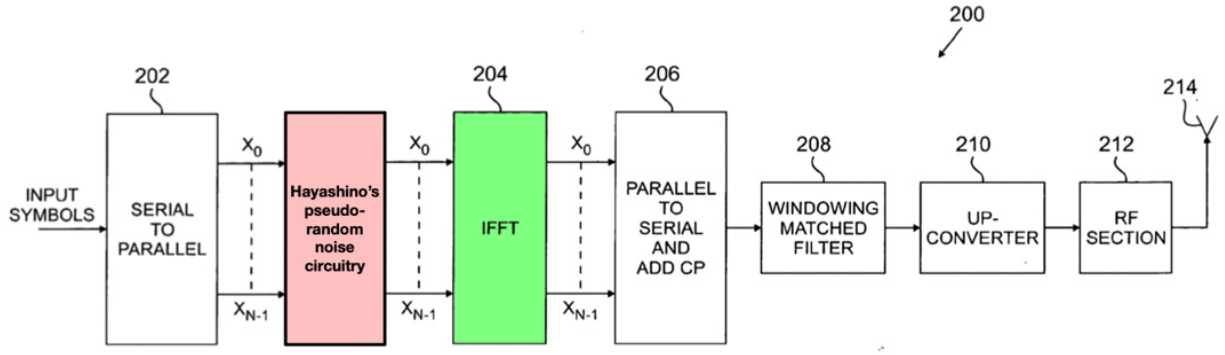


FIG. 2

FIGURE 2 OF CLEVELAND



COMBINATION OF CLEVELAND AND HAYASHINO

131. A POSITA would have understood that Cleveland's serial data signal or "Input Symbols" shown in Figure 2 corresponds to "input bit stream 250" from Figure 4 of the '566 patent (reproduced below). DISH-1001 at 5:59-6:10, FIG. 4; DISH-1006 at FIG. 2.

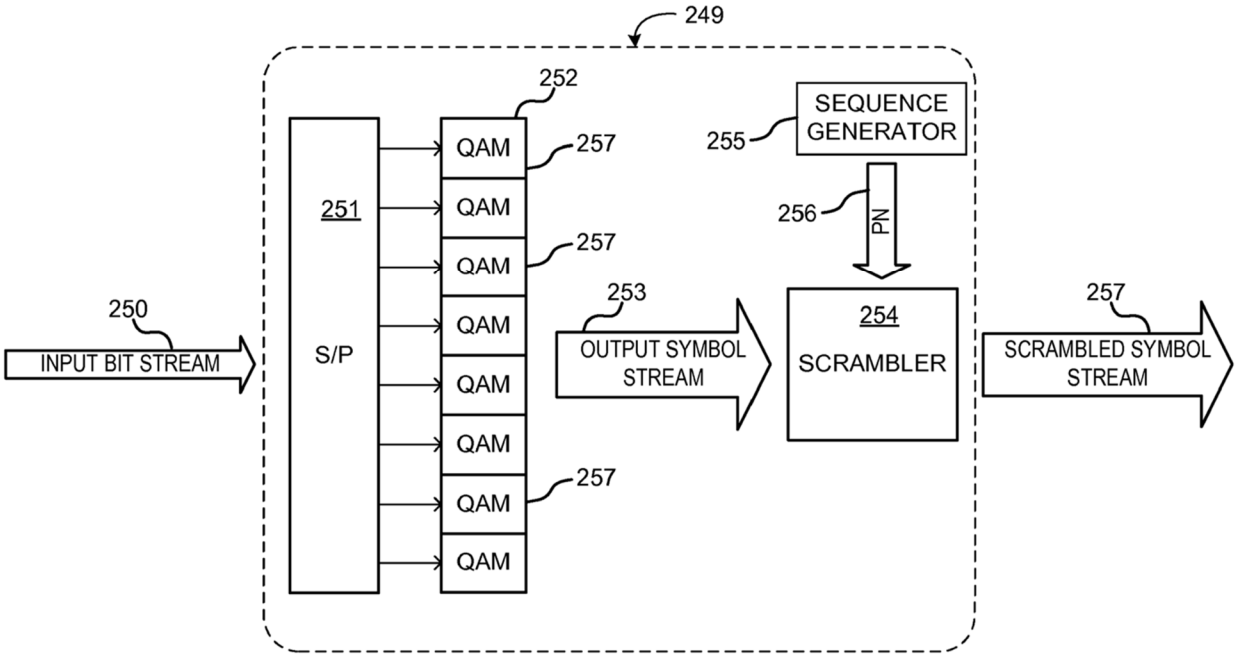


Fig. 4

FIGURE 4 OF '566 PATENT

132. Separately, Hayashino also discloses element 1d. In my opinion, a POSITA would have reasonably expected to succeed in combining Cleveland and Hayashino as described to utilize Cleveland's transmitting and mapping functions because Hayashino discloses the same functions recited in element 1d.

133. For subpart [1d.i], Hayashino discloses a transmitter, in Figure 1:

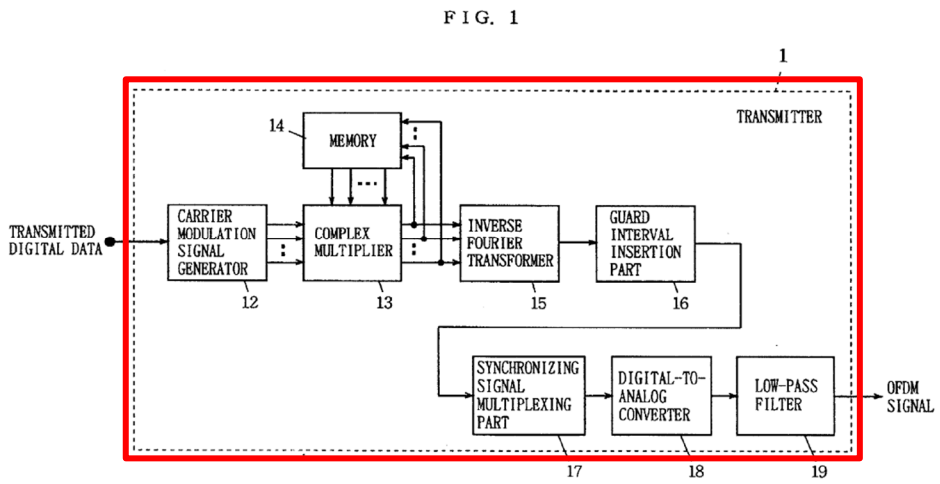


FIGURE 1 OF HAYASHINO

DISH-1007 at 7:45-50, FIG. 1. This transmitter would be present in each base station and remote device in the network.

134. For subpart [1d.ii], Hayashino maps a packet onto available subcarriers by converting a serial signal into multiple parallel signals. DISH-1007 at 7:51-60. For example, Figures 1 and 9[6] disclose a "carrier modulation signal generator 12" which "digital-modulates the inputted transmitted digital data and serial-to-parallel converts the same in every symbol interval, thereby converting the data to a carrier modulation signal group." DISH-1007 at 7:51-57, FIGS. 1, 9.

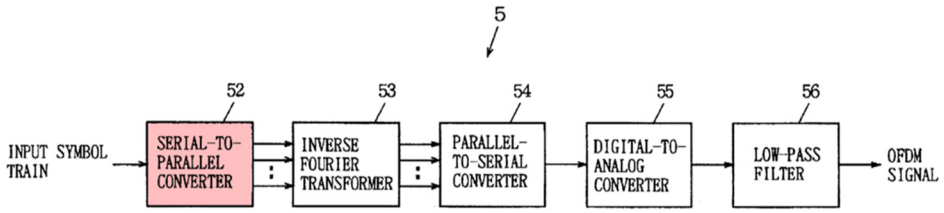
135. For subpart [1d.iii], Hayashino's mapping uses QAM. DISH-1007 at 7:51-60. For instance, Hayashino's "digital modulation is performed by . . . 16 QAM

[6] Figure 9 is identical to Figure 1 with the addition of Specific Pattern Generator 31, and the description of the common elements of Figure 1 apply to Figure 9. DISH-1007 at 12:24-27.

[and] in this stage is similar to that outputted from the serial-to-parallel converter 52 (see FIG. 13) of the conventional transmitter." *Id.*, 7:57-64, FIGS. 1, 9, 13.

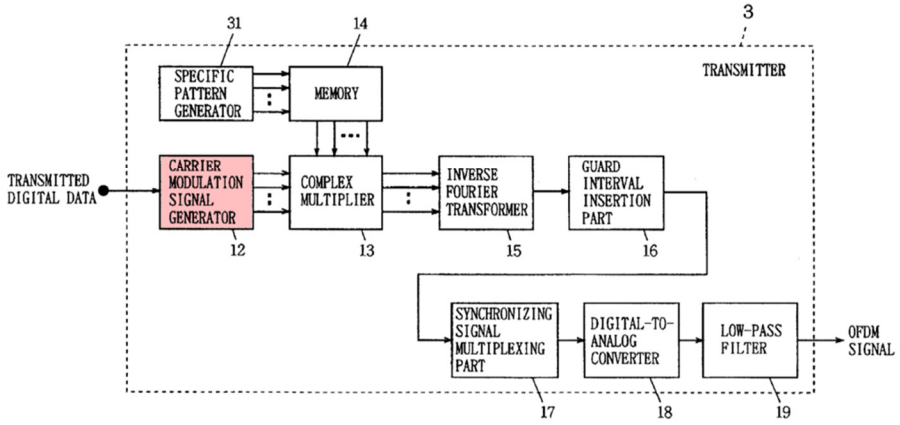
Conventional Transmitter

FIG. 13



Hayashino Embodiment

FIG. 9



FIGURES 13 AND 9 OF HAYASHINO

Thus, Cleveland and Hayashino render obvious element 1d.

136. In my opinion, the similarities between Cleveland and Hayashino indicate that a POSITA would have had a reasonable expectation of success in combining the references.

6. Element 1e

[1e] "e) the transmitting network device [i] performing a predetermined transformation on a quadrature amplitude modulated symbol [ii] using the element of the pseudorandom noise sequence corresponding to the used subcarrier"

137. It is my opinion that Hayashino discloses 1e through using pseudo-random sequences to vary carrier signal phase and that Cleveland discloses the remainder of element 1e; Cleveland-Hayashino renders this element obvious.

138. Cleveland-Hayashino renders obvious 1e through Hayashino's introduction of pseudo-random sequences to vary carrier signal phase (with Cleveland disclosing the remainder of the element). DISH-1007 at 12:27-48, FIG. 9.

139. To begin, Hayashino's transmitter is the "transmitting network device" that performs the predetermined transformation.

140. For subpart [1e.i], the output of Hayashino's specific pattern generator represents "performing a predetermined transformation on a [QAM] symbol." For example, Hayashino's transmitter features "memory 14 [that] holds an output of a specific pattern generator 31, i.e., a complex signal group D_0 having a predetermined specific pattern with signals which mutually vary in phase at random" wherein "complex signal group D_0 can be formed by a pseudo-noise signal generator comprising a PN series pseudo-random signal generator." *Id.*, 12:27-35, 12:43-48. To be clear, I note that specific pattern generator 31 is a pseudorandom noise sequence generator.

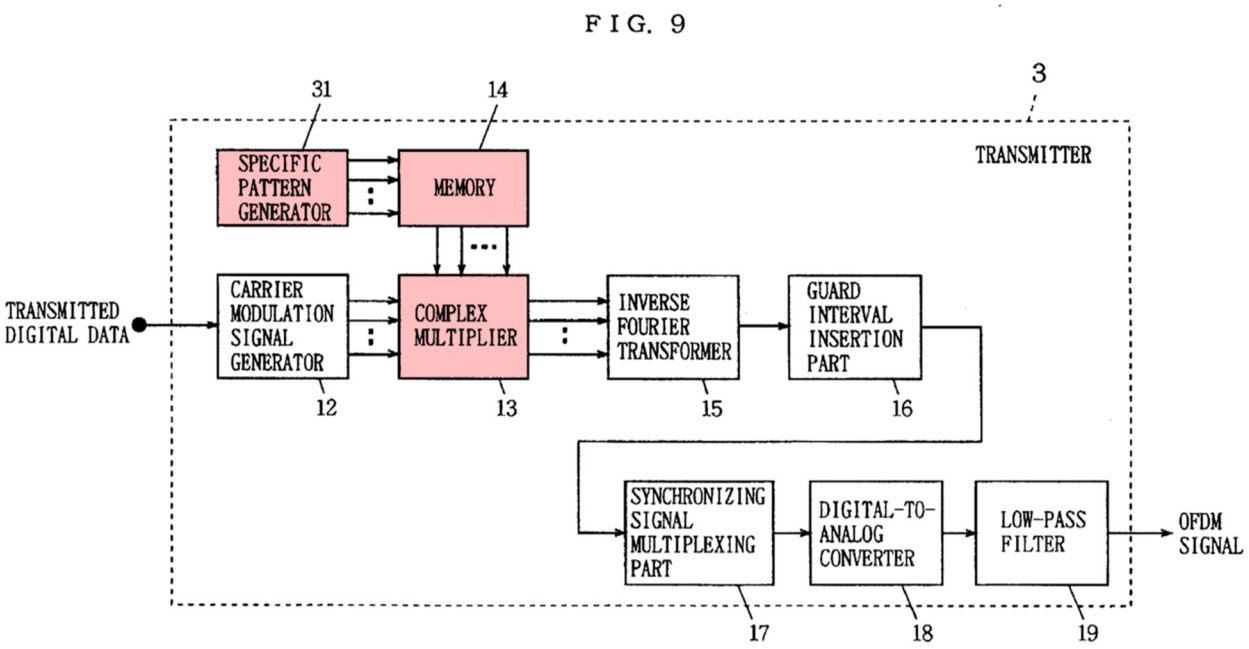


FIGURE 9 OF HAYASHINO

In Hayashino, "[t]he digital modulation is performed by" modulation signal generator 12" and may be "16 QAM." DISH-1007 at 7:51-64, FIGS. 1, 9, 13.

141. Based on the above, a POSITA would have understood that specific pattern generator 31's "predetermined specific pattern" is "performing a predetermined transformation on a quadrature amplitude modulated symbol" output by Carrier Modulation Signal Generator 12.

142. For subpart [1e.ii], a POSITA would have understood that Hayashino uses "the element of the pseudorandom noise sequence corresponding to the used subcarrier" when it performs the multiplication depicted in Figure 11 (below) and the IFFT 15 allots a carrier modulation signal D'm to respective carriers. DISH-1007 at 13:8-28.

FIG. 11

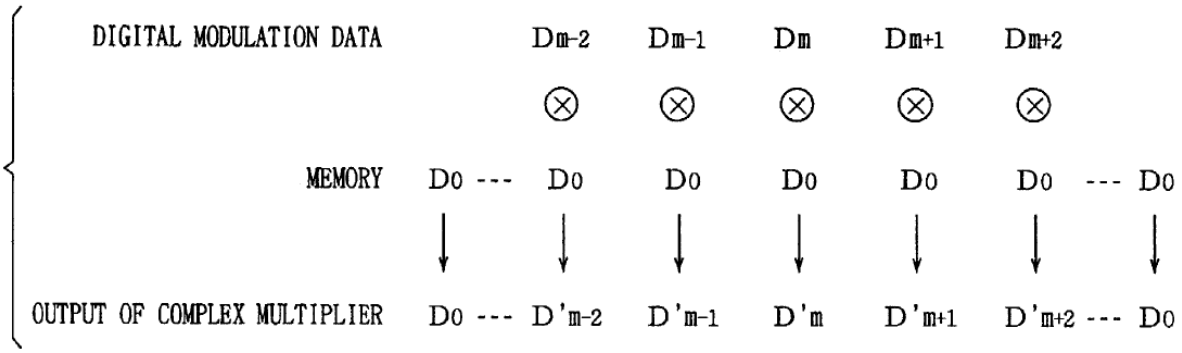


FIGURE 11 OF HAYASHINO

7. Element 1f

[1f] "f) the transmitting network device transmitting the transformed symbol to a receiving network device."

143. It is my opinion that Cleveland and Hayashino each discloses 1f and that Cleveland-Hayashino renders this element obvious.

144. Cleveland discloses a transmitter and corresponding receiver in Figures 2 and 3 (below), respectively. DISH-1006 at ¶ 38, FIGS. 2, 3. In Cleveland, transmitter 200 "constructs . . . an OFDM/OFDMA composite signal" that is ultimately "transmitted via antenna 214." DISH-1006 at ¶¶ 36-37. "OFDM/OFDMA receiver 300 detects the transmitted symbols and essentially reverses the process implemented by transmitter 200 described above." DISH-1006 at ¶ 38, FIGS. 2, 3.

Cleveland Transmitter

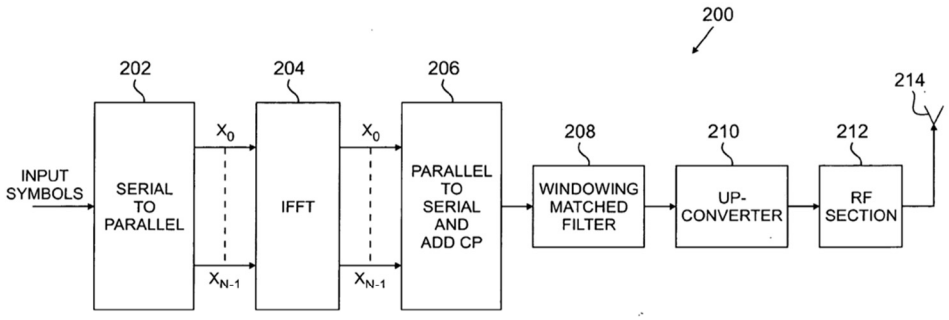


FIG. 2

Cleveland Receiver

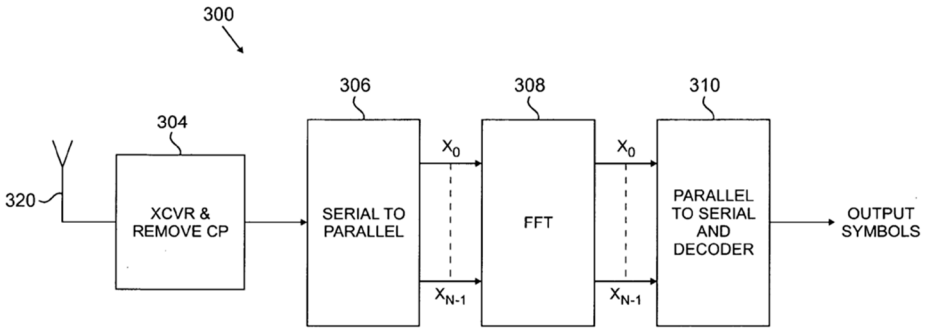


FIG. 3

FIGURES 2 AND 3 OF CLEVELAND

145. Similarly, Hayashino discloses a transmitter and corresponding receiver. DISH-1007 at 7:26-44, FIGS. 1, 2. Hayashino's transmitter "outputs the OFDM signal including the guard intervals and the synchronizing signal to the transmission path" and its receiver receives the "OFDM signal . . . through the transmission path." DISH-1007 at 7:45-9:32, FIGS. 1-2.

146. The Cleveland-Hayashino transmitter, and its corresponding receiver, would not alter either Cleveland or Hayashino's principle of operation, as including

Hayashino into Cleveland represents a simple addition rather than a modification or substitution in either reference.

E. Claim 2

1. Preamble

> [2pre] "The method of claim 1, wherein the steps of providing a corresponding element of a pseudorandom noise sequence and performing a predetermined transformation comprise:"

147. I have been asked to consider whether the combination of Cleveland and Hayashino renders obvious the preamble of claim 2, but I have not been asked to render an opinion on whether the preamble should be considered a limitation. If the preamble of claim 2 is deemed to be a limitation, it is my opinion that the Cleveland and Hayashino combination renders the preamble obvious for the reasons discussed under Ground 1, elements 1b, 1e, 2a, and 2b.

2. Element 2a

> [2a] "a) the transmitting network device [i] receiving an initial pseudorandom noise sequence element from a pseudorandom noise sequence generator, [ii] the initial pseudorandom noise sequence element corresponding to a first available subcarrier and [iii] transforming the symbol to be transmitted on the first available subcarrier if the first available subcarrier is a used subcarrier; and"

148. It is my opinion that Hayashino discloses 2a and that Cleveland-Hayashino renders this element obvious.

149. With respect to the term "used subcarrier," I note that the '566 patent explains that the "used subcarriers represent the sum of the subcarriers used by the individual transmitting network devices during the OFDMA communications period." DISH-1001 at 7:63-65. Thus, in my opinion, "used subcarrier" does not convey any specialized definition.

150. For subpart [2a.i], Hayashino's "specific pattern generator 31" is a pseudorandom noise sequence generator. Hayashino's transmitter receives a PN sequence element from the pattern generator 31 when it sends an OFDMA transmission. DISH-1007 at 12:27-42.

151. For subpart [2a.ii], Hayashino discloses using a pseudorandom signal generator to provide unique values for carrier modulation signals:

> interval by data D0 on the frequency axis every time data Dm is inputted for forming data D'm (D'm=Dm×D0), thereby randomizing mutual phases of respective carrier modulation signals included in a carrier modulation signal group to specific patterns.

DISH-1007 at 12:43-48. In randomizing "respective" carrier signals, a POSITA would have understood or found it obvious to use the elements from Hayashino's pseudorandom signal generator on each subcarrier.

152. For subpart [2a.iii], Hayashino transforms a symbol to be transmitted onto the first available subcarrier when it performs serial-to-parallel conversion and QAM modification. See DISH-1007 at 12:43-48.

153. Accordingly, a POSITA would have understood that when using one of Hayashino's PN sequence elements to modulate a particular symbol, the PN sequence element corresponds to the used subcarrier (as explained in element 1e above). DISH-1007 at 13:35-40, FIGS. 1, 2, 9.

154. Due to the synchronization between transmitting and receiving devices, this correspondence applies equally to all PN sequence element/subcarrier combinations, including the initial PN sequence element and first available subcarrier. Put simply, a POSITA would have understood that the transmitter and receiver in an OFDMA system must use the same PN sequence element to split/compile a signal.

3. Element 2b

> [3b] "b) the transmitting network device advancing the pseudorandom noise generator to receive a next element of the pseudorandom noise sequence corresponding to a next available subcarrier and transforming the symbol to be transmitted on the next available subcarrier if the next available subcarrier is a used subcarrier."

155. It is my opinion that Hayashino discloses element 2b and that Cleveland-Hayashino renders this element obvious.

156. As discussed under elements 1e and 2a, Hayashino teaches PN sequence elements that correspond to used subcarriers. DISH-1007 at 12:27-48, FIG. 9. A POSITA would have understood that for each subcarrier to have its own PN value,

the PN sequence generator must advance to the next element, which is provided to the complex multiplier 13 for use in serial-to-parallel conversion. DISH-1007 at 12:27-48, FIG. 9. A POSITA would have also understood that the PN generator must advance to the next element to avoid applying the same mathematical operator to adjacent subcarriers.

157. With respect to the phrase "advancing the pseudorandom noise generator to receive a next element of the pseudorandom noise sequence," is referring to advancing the pseudorandom noise sequence generator—in this case "to receive" conveys using the next element in the pseudorandom noise sequence.

158. Thus, Cleveland-Hayashino renders claim 2 obvious.

F. Claim 3

> [3] "The method of claim 2, wherein the step of the transmitting network device advancing the pseudorandom noise generator is repeated until a symbol to be transmitted on a last used subcarrier is transformed."

159. It is my opinion that Cleveland-Hayashino renders claim 3 obvious.

160. As discussed under element 1b and claim 2, Hayashino discloses that "specific pattern generator 31" can be implemented by "a PN series pseudo-random signal generator." DISH-1007 at 12:27-38, FIG. 9. Hayashino explains that "[t]he complex multiplier 13 repeats such an operation for a prescribed period." DISH-1007 at 13:7-8. Hayashino also explains that the PN sequence is

advanced or incremented until a symbol to be transmitted on a last used subcarrier is transformed. *Id.*, 12:43-48 ("A complex multiplier 13 complex-multiplies data Dm of each symbol interval by data DO on the frequency axis every time data Dm is inputted . . . ."), FIG. 9.

161. A POSITA would have understood that each subcarrier should receive its own pseudorandom element to realize the PAR reduction Hayashino touts. See § VII.B. (Combination of Cleveland and Hayashino). In other words, a POSITA would have understood that claim 2's advancing-PN-generator step results in Cleveland-Hayashino repeating the step until a symbol to be transmitted on a last used subcarrier is transformed.

162. For example, Mutagi discloses the use of "[p]seudo random binary sequences (PRBSs), also known as pseudo noise (PN) [or] linear feedback shift register (LFSR) sequences" in OFDM communications. DISH-1014 at 79-80. Gupta and Vijayan also disclose OFDM communication systems that utilize "PN generator 1620 . . . with a 15-tap linear feedback shift register (LFSR)." DISH-1012 at 17:17-20; DISH-1013 at 7:21-23.

VII. GROUND 1B – CLEVELAND-HAYASHINO IN VIEW OF MUTAGI

A. Overview of Mutagi (DISH-1014)

163. Mutagi reflects a POSITA's understanding of pseudorandom (PN) sequences. For example, Mutagi summarizes "the fundamentals and the

applications of PN sequences, and the methods of generating them with hardware" for the "practicing engineer." DISH-1014 (Abstract). Mutagi explains that "[p]seudo random binary sequences (PRBSs), also known as pseudo noise (PN), linear feedback shift register (LFSR) sequences or maximal length binary sequences (msequences), are widely used in digital communications." DISH-1014 at 79. Mutagi notes that, amongst other things "PN sequences are also used for scrambling the data, at the same rate, to obtain even spectral energy distribution within the signal band." DISH-1014 at 87. Mutagi discloses many PN sequences—Table 2 shows PN sequences of 2-25 bits:

Table 2: Some feedback taps for maximal sequence length

No. of stages, *N*	Code length, *L*	No. of codes, *C*	Some tap sets used for feedback
2*	3	1	[2, 1]
3*	7	2	[3, 2] [3, 1]
4	15	2	[4, 3] [4, 1]
5*	31	6	[5, 3] [5, 2]
6	63	6	[6, 5] [6, 1]
7*	127	18	[7, 6] [7, 3] [7, 1]
8	255	16	[8, 6, 5, 4] [8, 6, 5, 3]
9	511	48	[9, 5] [9, 6, 4, 3]
10	1 023	60	[10, 7] [10, 3]
11	2 047	176	[11, 9] [11, 8, 5, 2]
12	4 095	144	[12, 6, 4, 1]
13*	8 191	630	[13, 4, 3, 1]
14	16 383	756	[14, 5, 3, 1]
15	32 767	1 800	[15, 14] [15, 4]
16	65 535	2 048	[16, 15, 13, 4]
17*	131 071	7 710	[17, 14] [17, 3]
18	262 143	7 776	[18, 11[[18, 7]
19*	524 287	27 594	[19, 6, 2, 1]
20	1 048 575	24 000	[20, 17] [20, 3]
21	2 097 151	84 672	[21, 19] [21, 2]
22	4 194 303	120 032	[22, 21] [22, 1]
23	8 388 607	356 960	[23, 18] [23, 5]
24	16 777 215	276 480	[24, 23, 22, 17]
25	33 554 431	1 296 000	[25, 22] [25, 3]

TABLE 2 OF MUTAGI

DISH-1014 at 83-84. The entirety of Mutagi's discussion, in general, focuses on a PN-15 sequence. Figure 7, for example, denotes a PN-15 sequence ($1 + x^{14} + x^{15}$):

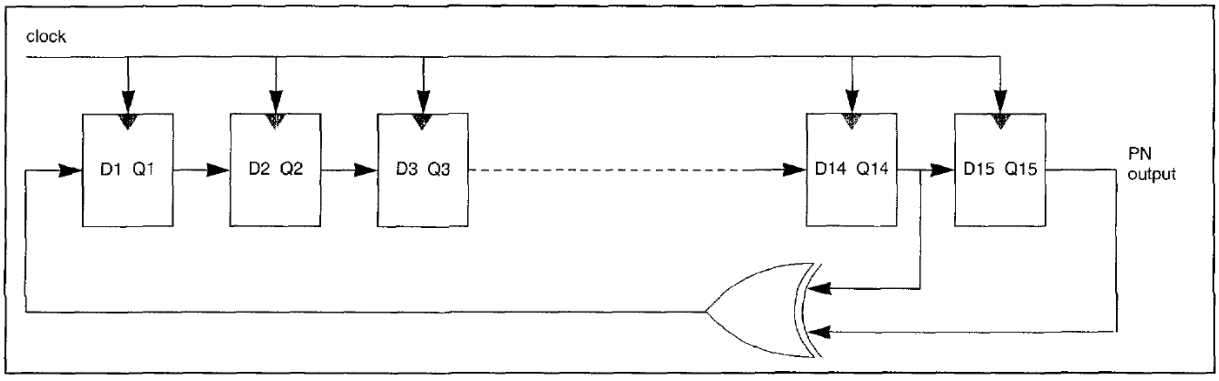


Fig. 7 A PN generator with polynomial $1 + x^{14} + x^{15}$

FIGURE 7 OF MUTAGI

See DISH-1014 at 83.

164. To further show that using PN sequences was known, I note that DISH-1017 (Scheim) uses PN sequences in OFDM/OFDMA systems.

B. Cleveland-Hayashino in view of Mutagi

165. A POSITA familiar with the art would know that using pseudorandom sequences is a well-known signal processing technique, as Mutagi shows.

166. Mutagi explains pseudorandom noise sequences "are widely used in digital communications," which describes the references I have reviewed and discussed in this declaration. Mutagi's discussion of PN sequences is highly applicable to multiplex communication in networks using orthogonal techniques, given concerns over interference. Further, Mutagi is reasonably pertinent to the problems that the '566 patent's inventors faced, e.g., interference in OFDM/OFDMA systems.

167. Mutagi discloses twenty-four PN sequences, ranging in length from 2-25. DISH-1014 at 83-84. A POSITA would also know that selecting the length is a design choice that involves assessing the complexity desired against the cost of the shift register. DISH-1014 at 84 ("When the length *N* is large, more logic is needed with this technique to decode 'all zeros'."), 85 "(. . . the register length becomes prohibitive for large *L*."). Similarly, a POSITA would have understood that longer PN sequences generate more unique PN codes and that the number of users of a given system influences, or completely dictates, the length of the PN sequence required. See DISH-1014 at 83 and Table 2. Accordingly, a POSITA would find it obvious to try using any of the twenty-four PN sequences Mutagi discloses and to select a PN sequence that is appropriate for their particular application.

C. Claim 4

> [4] "The method of claim 1, wherein the pseudorandom noise sequence comprises a PN-15 sequence."

168. It is my opinion that Cleveland-Hayashino, particularly in view of a POSITA's background knowledge, renders claim 4 obvious. Mutagi is representative of a POSITA's background knowledge.

169. As noted above, Hayashino's specific pattern generator generates a pseudorandom noise sequence. See § VI.D.3 (element 1b). Mutagi discloses 24 PN sequences, and it specifically discloses "a 15 bit PN sequence" throughout its discussion. DISH-1014 at 80, FIG. 1. Because Mutagi discloses many PN

sequences including a PN-15 sequence, and because a POSITA would have found it obvious to try using any of those sequences, a POSITA would have found claim 4 obvious.

VIII. GROUND 1C – CLEVELAND-HAYASHINO IN VIEW OF MUTAGI AND TING

A. Overview of Ting (DISH-1015)

170. Ting is a doctoral thesis that discloses a technique that aims to reduce the complexity associated with a preamble search in OFDMA systems. DISH-1015.

171. Ting explains that pilot symbols are used "for synchronization and channel estimation." DISH-1015 at 23. Ting explains that, in its technique, subcarriers are multiplied by a "sequence to achieve randomization effect." DISH-1015 at 23. In particular, Ting teaches that subcarriers can be randomized by multiplying each symbol against this factor:

$$2 \times (\frac{1}{2} - W_k)$$

DISH-1015 at 24 ("The subcarrier randomization is accomplished as each modulated data subcarrier is multiplied by the factor [above.]").

B. Cleveland-Hayashino in view of Mutagi and Ting

172. A POSITA would have been motivated to increase the randomization in pilot signals in Cleveland-Hayashino-Mutagi's network to decrease the potential interference in the network further. Further, because pilot signals are critically

important to system operation, a POSITA would be motivated to ensure that the pilot signal is not lost due to intereference. To avoid this problem, a POSITA would have been motivated to use an approach like Ting's, which helps ensure that network devices receive the appropriate pilot signals. In this respect, applying Ting's teachings improves Cleveland-Hayashino with respect to pilot signals.

173. Ting is directed to an OFDMA system, which describes the references I have reviewed and discussed in this declaration. Ting's randomization methodology pertains to multiplex communication in networks using orthogonal techniques. These types of networks face power concentration challenges, and Ting would help alleviate those challenges. Accordingly, Ting is reasonably pertinent to the problems that the '566 patent's inventors faced, e.g., interference in OFDM/OFDMA systems.

C. Claim 5

> [5] "The method of claim 4, wherein the step of performing the predetermined transformation comprises rotating the quadrature amplitude modulated symbol by 180° if the element of the pseudorandom noise sequence is a '1' and not modifying the quadrature amplitude modulated symbol if the element of the pseudorandom noise sequence is a '0'."

174. It is my opinion that Ting discloses the subject matter of claim 5, and that Cleveland-Hayashino, in view of Mutagi and Ting, renders claim 5 obvious.

175. Ting teaches multiplying pilot symbols by this factor:

$$2 \times (\frac{1}{2} - W_k)$$

DISH-1015 at 23-24. As a POSITA would have understood, when a bit stream is multiplied by Ting's factor, the resultant product rotates a "1" to a "-1" and a "0" to a "1", which rotates the symbol (on a QAM constellation) by 180°.

IX. GROUND 1D: CLEVELAND-HAYASHINO IN VIEW OF MUTAGI AND OHANA

A. Overview of Ohana (DISH-1016)

176. Ohana explains that, in February 2006, the MoCA alliance had introduced a specification disclosing "technologies [that] provide throughput through the existing coaxial cables to the places where the video devices are located in a structure without affecting other service signals that may be present on the cable." DISH-1016 at ¶¶ 7, 29.[7]

177. Ohana further explains that its networks are "coordinated networks, in which a processing unit serves as a network coordinator." DISH-1016 at ¶¶ 11, 12. Ohana also teaches that known coordinated networks, such as MoCA networks, use reservation requests. DISH-1016 at ¶¶ 11, 12. Ohana aims to improve on known MoCA networks by reducing the latency associated with delivering reservation requests. DISH-1016 (Abstract).

[7] MoCA 1.0 was introduced in 2006. DISH-1016 at ¶29, DISH-1001 at 1:66-67

B. Cleveland-Hayashino in view of Mutagi and Ohana

178. A POSITA would have understood that Ohana discloses known components in a coordinated network—i.e., network coordinators and reservation requests. A POSITA looking to increase data speeds on Cleveland-Hayashino's network would have been motivated to use Ohana's persistent reservation requests because they reduce reservation-request latency. DISH-1016 at ¶¶ 13, 15, 29.

179. In the 2000's, wireless customers were demanding increased data speeds. See DISH-1008 at 10 ("The demand for high data rate wireless multi-media applications has increased significantly in the past few years."). The demand for high-speed wireless data was the impetus for LTE and WiMAX development. DISH-1008 at 10 ("The recent [development] strategy followed within ETSI 3GPP LTE and the WiMAX Forum was an evolutionary concept, especially for mobile applications. Both have adopted a new PHY layer multi-carrier transmission with a MIMO scheme, a promising combination offering a high data rate at low cost.").

180. Further, a POSITA would have had a reasonable expectation of success in using Ohana's persistent reservation requests in Cleveland-Hayashino, because implementing the p-RR's would have been an exercise of ordinary skill.

181. Ohana explains that its methods "may be used in connection with" MoCA 1.0, which is an OFDM network. DISH-1033 (Monk) at 2328 ("TheMoCA 1.0 and MoCA 1.1 PHY layers are identical. Both use bitloaded OFDM with 224

subcarriers in a 50-MHz channel."). Ohana adds that it can be used in any coordinated network, which also describes an OFDM/OFDMA network. Accordingly, Ohana pertains to multiplex communication in networks using orthogonal techniques, and it is reasonably pertinent to the problems that the '566 patent's inventors faced, e.g., coordinating communication in OFDM/OFDMA systems.

C. Claim 6

> [6] "The method of claim 4, wherein the receiving network device comprises a network coordinator and wherein the packet comprises a resource reservation request packet."

182. It is my opinion that Cleveland-Hayashino, in view of Mutagi and Ohana, renders claim 6 obvious.

183. In the '566 patent, the network coordinator (NC) is a device in a multi-device system that "allocate[s] network bandwidth" among the devices. DISH-1001 at 4:35-46. In coaxial home networks, this is performed by allowing "network devices to transmit a Reservation Request[s] (RR) . . . for a certain amount of bandwidth at a certain time." *Id*. The '566 patent explains that "[t]he required time to receive these RRs grows with the size of the network." *Id*., 4:46-48.

184. Ohana Figure 4 discloses a network 400 that includes a network coordinator 408:

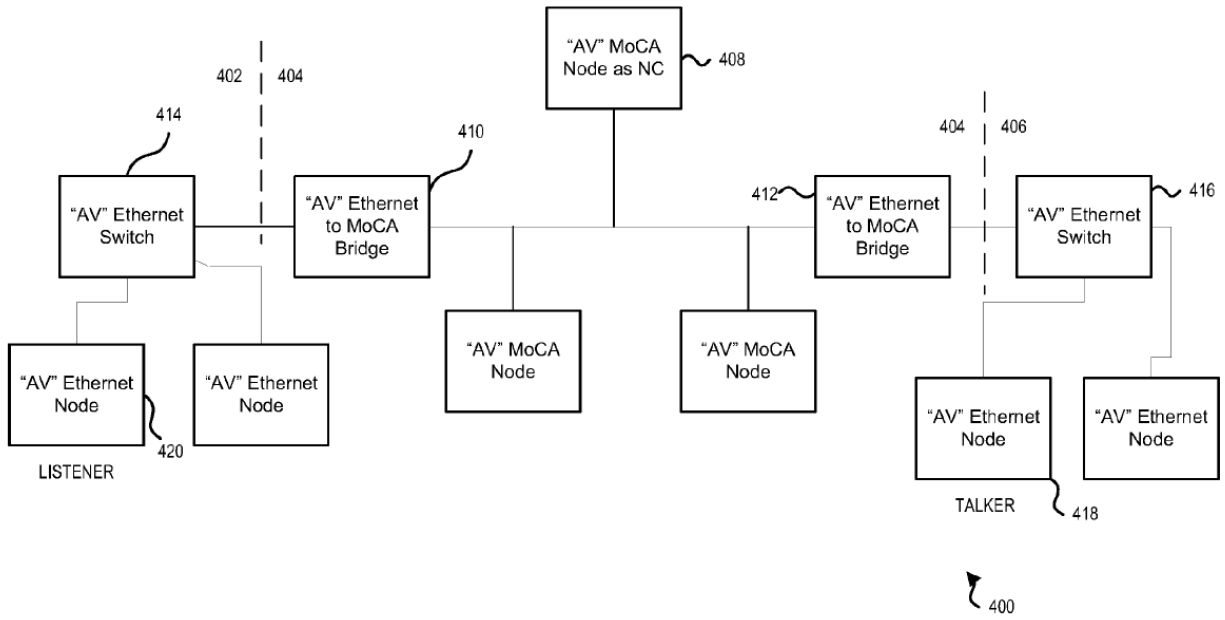


FIGURE 4 OF OHANA

DISH-1016 at ¶ 41. Ohana's network uses persistent reservation requests ("p-RR") that "request allocation of network resources for transmitting the data. DISH-1016 at ¶¶ 29-30. Ohana thus discloses claim 6's network coordinator and reservation requests. Accordingly, in view of Ohana, modifying Cleveland-Hayashino's receiver to be a network coordinator wherein the packet comprises a resource reservation request packet would have been obvious to a POSITA.

D. Claim 12

> [12] "The method of claim 4, wherein the method is performed by a network coordinator and wherein first and second scrambled orthogonal frequency division modulation symbols are contained in a resource reservation request packet.

185. It is my opinion that Cleveland-Hayashino, in view of Mutagi and Ohana, renders claim 12 obvious based on the analysis presented above.

186. A POSITA would have found it obvious to include a scrambled OFDMA symbol in a resource reservation request packet because multiplexed systems, such as OFDM/OFDMA and ADSL, typically deliver reservation requests over multiple subchannels, which requires using at least two scrambled orthogonal frequency division modulation symbols. DISH-1016 at ¶ 8. Additionally, including the scrambled OFDMA symbol in a resource reservation request lowers PAR across the network. In this respect, a POSITA would have been motivated to use Cleveland-Hayashino's approach in reservation requests, to realize Cleveland-Hayashino's benefits across the network's entire operation.

X. GROUND 2A: SCHEIM AND TZANNES

A. Overview of Scheim (DISH-1017)

187. Scheim addresses interference in OFDMA communications networks that use multiple-input multiple-output (MIMO) techniques. DISH-1017 (Abstract), ¶¶ 2, 5-7, 14, 21, 39-40. Scheim addresses interference by providing a "resource allocation mechanism" that "spreads the resource allocation in each cell in a random manner." DISH-1017 at ¶ 41.

188. Resource allocation is "a problem of how to optimally allocate resources (i.e. power and rate) across a set of parallel and independent dimensions in

frequency, time (fading state) and space (multiple antennas) given channel conditions[.]" DISH-1017 at ¶ 36.

189. As background, Scheim explains that MIMO systems "employ an array of antennas at both the transmitter and the receiver." DISH-1017 at ¶¶ 6-10. Such systems often utilize "OFDM, a digital multi-carrier modulation scheme," and "OFDMA is a multi-user version of the OFDM digital modulation scheme." DISH-1017 at ¶¶ 11-15.

190. In prior OFDM networks, as Scheim explains, resource allocation was achieved by forwarding a "resource allocation scheme generated by block 356 . . . to the OFDM transmitter" where "[t]he transmitter [] selects different amounts of data for the users to form an OFDM symbol." DISH-1017 at ¶¶ 34-35, FIG. 5.

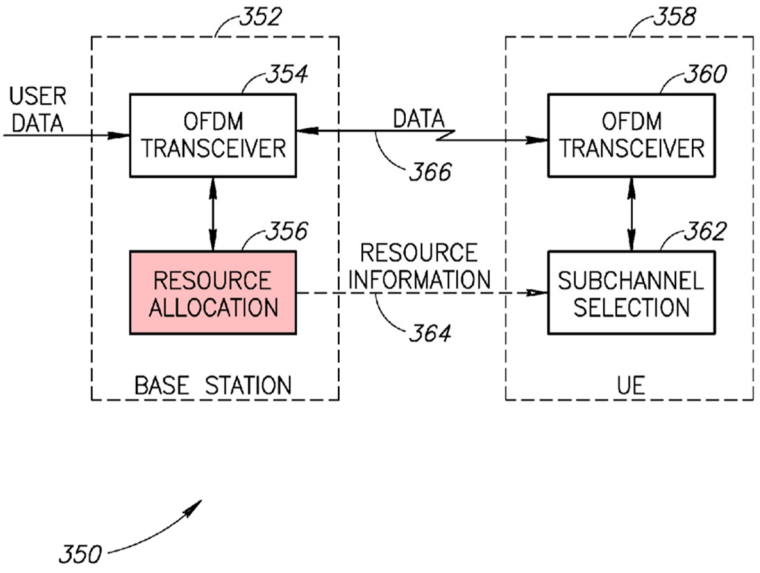


FIG.5
PRIOR ART

FIGURE 5 OF SCHEIM (PRIOR ART)

191. Scheim explains that resource allocation can be complex for two reasons—(1) a large number of users and (2) inter-cell interference. DISH-1017 at ¶ 37. A large number of users in a cell presents a control-signal challenge, because each user requires a unique control signal that "specif[ies] the corresponding resources allocated to it." DISH-1017 at ¶ 37. Inter-cell interference, which is caused by reusing the same resources over non-adjacent cells, presents a challenge because it required "complex and costly" "interference cancellation algorithms" to reduce the interference. DISH-1017 at ¶¶ 37-39.

192. To solve these challenges, Scheim discloses "a resource allocation scheme that functions to reduce inter-cell interference by randomizing the indices used to allocate resources in each cell." DISH-1017 at ¶¶ 105, 41, 84. Scheim notes that "effectively spreading the resources in each cell over the entire resource range in a random manner [] results in statistical-like inter-cell interference behavior." *Id.* In this respect, Scheim uses indices to distribute system resources, which includes OFDMA subchannels, randomly to various users on the network. DISH-1017 at ¶¶ 106, 115.

193. To distribute system resources randomly, Scheim "employs a sequence generator for generating the random sequence of indices . . . [that] may comprise any suitable random number generating means." DISH-1017 at ¶ 106. As Scheim Figure 9 below shows, Scheim discloses "a linear feedback shift register (LFSR) . .

. to efficiently generate a sequence (i.e. permutation)" during transmission where "a LFSR with m bits ensures the pseudo-random generation of all the indices from 1 to 2^m-1. DISH-1017 at ¶¶ 111-112, FIG. 9.

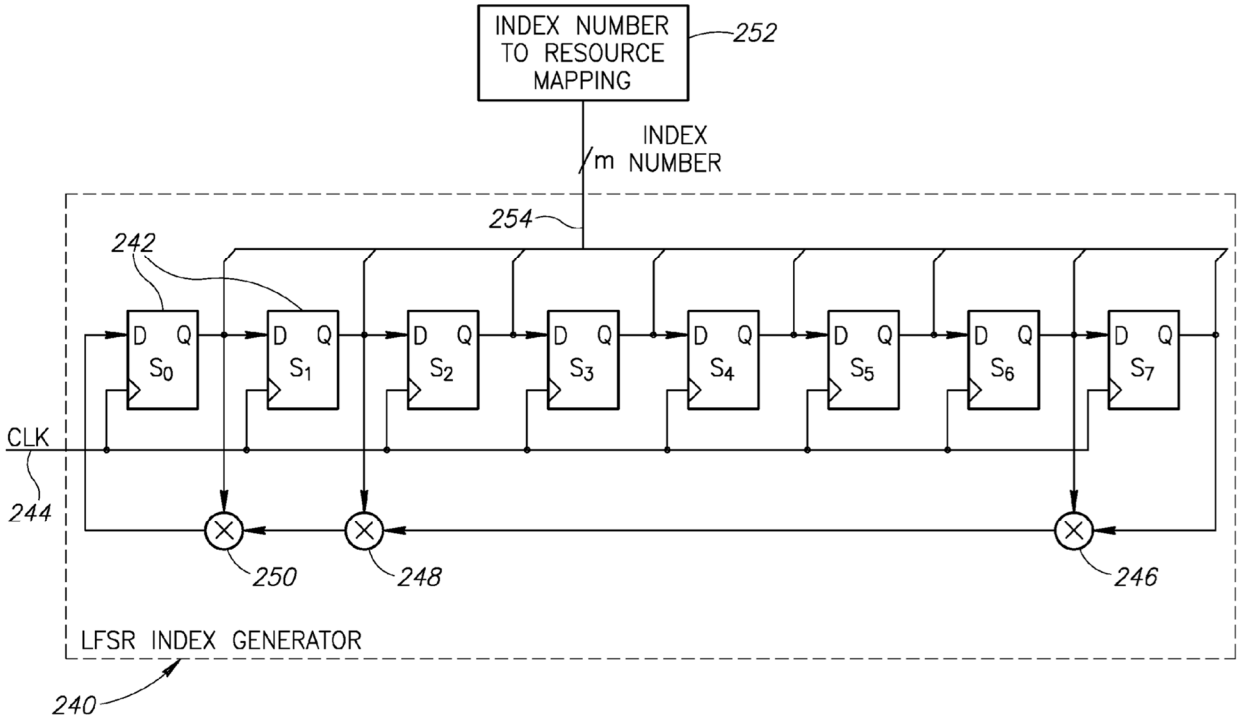


FIG.9

FIGURE 9 OF SCHEIM

194. Scheim discloses that when "a similar LFSR machine is employed at the receiver for calculating the corresponding permutation . . . the invention provides a relatively simple mechanism for the receiver to duplicate the sequence generated at the transmitter used to assign resources, when compared with other implementations." DISH-1017 at ¶ 113.

B. Overview of Tzannes (DISH-1009)

195. Tzannes addresses interference in communications networks, particularly with respect to carrier waves that constructively interfere with each other. DISH-1009 at 2:10-26.

196. Tzannes discloses that "[i]n a conventional multicarrier communications system, . . . [c]arrier signals (carriers) or sub-channels spaced within a usable frequency band of the communication channel are modulated at a symbol (i.e., block) transmission rate of the system." DISH-1009 at 1:25-32. However, "[i]f the phase of the modulated carriers is not random, then the [peak-to-average power ratio (PAR)] can increase greatly." DISH-1009 at 2:10-11.

197. High PAR is undesirable because it "can result in a system with high power consumption and/or with high probability of clipping the transmission signal." DISH-1009 at 2:20-23. Tzannes thus identifies "a need for a system and method that can effectively scramble the phase of the modulated carrier signals in order to provide a low PAR for the transmission signal." DISH-1009 at 2:23-26.

198. Accordingly, Tzannes discloses various phase scrambling techniques that apply to multicarrier modulation methodologies "such as, but not limited to, orthogonally multiplexed quadrature amplitude modulation (OQAM) . . . and orthogonal frequency division multiplexing (OFDM)." DISH-1009 at 3:33-36. Using a discrete multitone (DMT) transmitter as an example, Tzannes discloses a

transmitter and receiver featuring "(QAM) encoder 42 [blue], a modulator 46 [red], . . . and a phase randomizer 66 [green]" where "QAM symbols 58 represent the amplitude and the phase characteristic of each carrier signal." DISH-1009 at 3:52-4:12, FIG. 1.

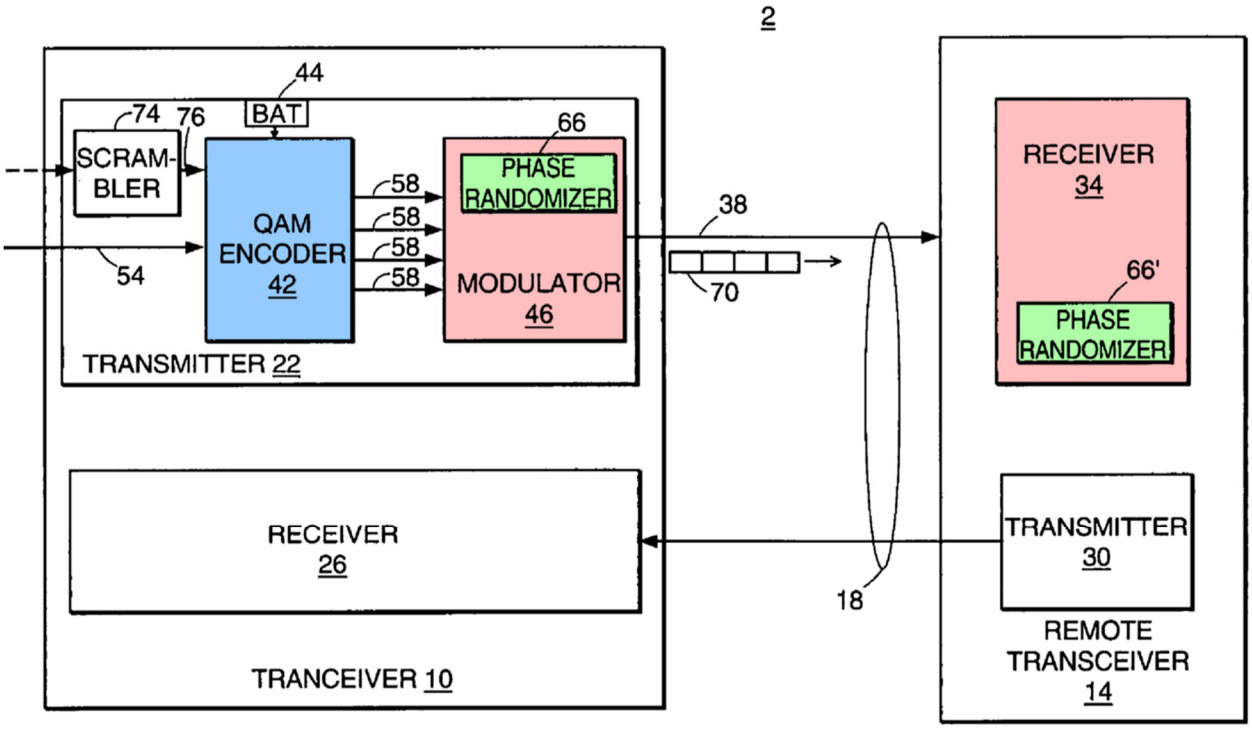


FIG. 1

FIGURE 1 OF TZANNES

199. "[P]hase scrambler 66 that combines a phase shift computed for each QAM-modulated carrier signal" resulting in "a substantially minimized [PAR]." DISH-1009 at 4:33-42. Finally, Tzannes teaches that "[t]he actual value(s) that the phase scrambler 66 associates with each carrier signal can be derived from . . . a pseudo-random number generator (pseudo-RNG)." DISH-1009 at 4:53-63.

C. Combination of Scheim and Tzannes

200. The Scheim-Tzannes combination combines Scheim's OFDMA network, and associated devices, and pseudorandom distributing techniques with Tzannes's pseudo-random phase shifting techniques, resulting in an OFDMA transmission scheme with improved bandwidth allocation and reduced PAR, which improves power consumption and lessens signal interference. DISH-1009 at 2:1-26, 3:1-2, 6:30-40.

201. Scheim and Tzannes are from the same field of endeavor, e.g., multiplex communication in networks using orthogonal techniques, and because both references are reasonably pertinent to the problems that the '566 patent's inventors faced, e.g., interference in OFDM/OFDMA systems. DISH-1017, Abstract, ¶¶2, 5-7, 14, 21, 39-40; DISH-1009, 2:10-26.

202. A POSITA would have been motivated to modify Scheim's network to incorporate Tzannes's approach. Both Scheim and Tzannes are directed to utilizing orthogonal frequency division data transmission techniques in communication networks.

203. For example, Scheim explains that its "present invention . . . relates to a resource allocation apparatus and method for use in an [OFDMA] communication system." DISH-1017 at ¶ 2.

204. Tzannes explains that "the principles of the invention apply" to OFDM:

> FIG. 1 shows a digital Subscriber line (DSL) communication System 2 including a discrete multitone (DMT) transceiver 10 in communication with a remote transceiver 14 over a communication channel 18 using a transmission
>
> signal 38 having a plurality of carrier signals. The DMT transceiver 10 includes a DMT transmitter 22 and a DMT receiver 26. The remote transceiver 14 includes a transmitter 30 and a receiver 34. Although described with respect to discrete multitone modulation, the principles of the invention apply also to other types of multicarrier modulation, such as, but not limited to, orthogonally multiplexed quadrature amplitude modulation (OQAM), discrete wavelet multitone (DWMT) modulation, and orthogonal frequency division multiplexing (OFDM).

DISH-1009 at 3:32-37.

205. Both Scheim and Tzannes are directed to improving inefficiencies in OFDM-based networks resulting from non-uniformly distributed carrier signals. Scheim explains that such signals "may cause interference to other cell transmissions" but "spreading the resources in each cell over the entire resource range in a random manner [] results in statistical-like inter-cell interference behavior." DISH-1017 at ¶¶ 37, 41. Tzannes explains that "[b]y scrambling the phase characteristics of the carrier signals, the resulting transmission signal 38 has a substantially minimized [PAR]." DISH-1009 at 4:39-42.

206. Thus, a POSITA seeking to improve Scheim's network, and interference on it, would have been motivated to look to similar communications technologies, like those in Tzannes, to reduce PAR.

207. Scheim further explains that conventional OFDM networks negotiate bandwidth by modulating and transmitting resource allocation data packets onto one or more subcarriers. DISH-1017 at ¶¶ 34-35, FIG. 5. However, the non-random distribution of that data increases inter-cell interference. DISH-1017 at ¶ 105.

208. A POSITA would have understood that PAR increases as inter-cell interference increases. Likewise, Tzannes explains that when phase-shifted QAM-modulated carrier signals are transmitted using conventional OFDM techniques without random scrambling, it produces a high PAR. DISH-1009 at 2:10-26. Thus, a POSITA looking to further improve the performance of Scheim's network would look to Tzannes's teachings to reduce PAR.

209. Moreover, both Scheim and Tzannes utilize QAM mapping to separate carrier signal phase (I or real) and quadrature (Q or imaginary) components for transmission. DISH-1017 at ¶ 11 ("[OFDM] . . . is well known in the art. It uses a large number of closely spaced subcarriers that are orthogonal to each other. Each subcarrier is modulated with a conventional modulation scheme [QAM]"); DISH-1009 at 3:32-35 ("the principles of the invention apply also to other types of multicarrier modulation, such as, . . . [QAM.]"). Accordingly, incorporating Tzannes's approach in Scheim's network would not have required reworking Scheim's principle of operation or rendered either reference inoperable.

210. These efficiencies and similarities across Scheim and Tzannes's teachings would have led a POSITA to use Tzannes's pseudo-random phase-randomizing techniques in Scheim's network. Incorporating Tzannes's phase-randomizing technique, and accompanying circuitry, into Scheim's OFDMA transceiver would have been an exercise of ordinary skill (depicted below).

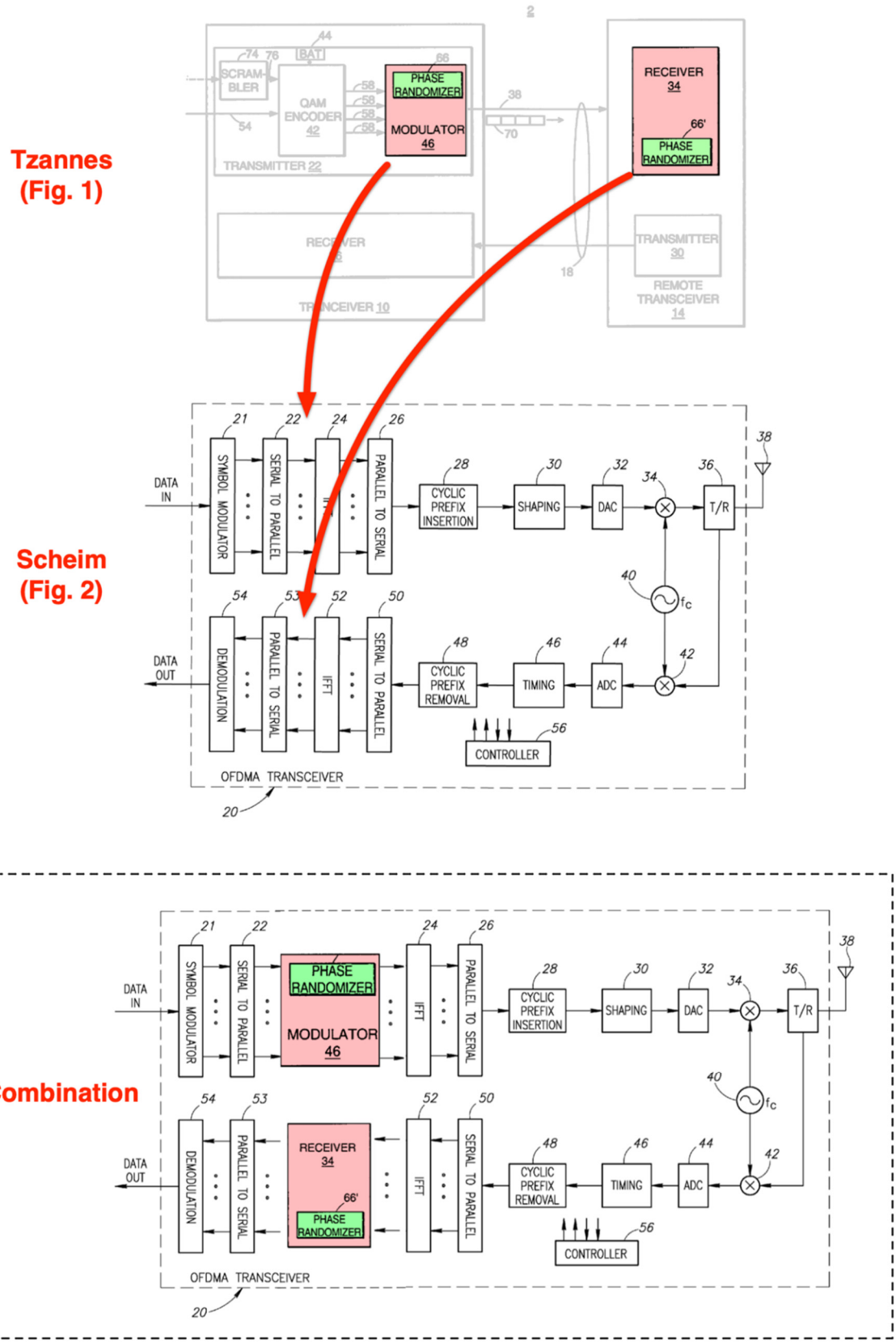


FIGURE 1 OF TZANNES; FIGURE 2 OF SCHEIM; COMBINATION

211. A POSITA would have had a reasonable expectation that the Scheim-Tzannes combination would work successfully, as intended. Incorporating pseudorandom circuitry requires basic engineering knowledge and is an ordinary engineering task. Indeed, Scheim discloses that a linear feedback shift register (LFSR) phase shifting circuit is employed to perform randomized resource allocation mapping. DISH-1017 at ¶¶ 107-113, FIGS. 7-8.

212. A POSITA would have recognized that a LFSR is a type of pseudo-random permutation. DISH-1017 at ¶ 113.

213. A POSITA would have reasonably expected that this combination would experience the PAR reduction Tzannes teaches.

214. Consistent with the teachings of Scheim and Tzannes, a POSITA would also have realized that PAR reduction is beneficial because it lessens signal interference, which in turn allows engineers (e.g., POSITAs) to use less-powerful transmitters, which would have reduced costs. DISH-1017 at ¶¶ 10, 16, 36-40, 105-113; DISH-1009 at 1:26-2:26.

215. Further, a POSITA would also have understood that lowering PAR allows the transmitter to operate at a higher power, thus extending range, or to conserve current, thus extending operating life in battery-powered devices.

D. Claim 1

1. Preamble

[1pre] "A method for communications transmission using orthogonal frequency division multiple access on a network comprising:"

216. I have been asked to consider whether the combination of Scheim and Tzannes renders obvious the preamble of claim 1, but I have not been asked to render an opinion on whether the preamble should be considered a limitation. If the preamble of claim 1 is deemed to be a limitation, it is my opinion that Scheim discloses the preamble and that the Scheim-Tzannes combination renders the preamble obvious.

217. Scheim comes from the OFDMA field. DISH-1017 at ¶ 2.

218. Scheim discloses a conventional OFDMA transceiver, which works in an OFDMA network. DISH-1017 at ¶¶ 11-15; FIG. 2.

219. Further, Scheim discloses methods for using OFDMA (particularly in connection with MIMO). DISH-1017 at ¶¶ 21, 45, 130.

220. Tzannes similarly discloses that "the principles of the invention apply also to other types of multicarrier modulation, such as . . . [OFDM]." DISH-1009 at 3:31-37, 3:47-51.

221. A POSITA would have understood that Tzannes's concepts were applicable to Scheim's OFDM/OFDMA networks.

2. Element 1a

> [1a] "a) providing a plurality of transmitting network devices with a set of available subcarriers for orthogonal frequency division multiple access"

222. It is my opinion that Scheim discloses element 1a and that Scheim-Tzannes renders this element obvious.

223. Scheim discloses that "[m]ultiple access is achieved in OFDMA by assigning subsets of subcarriers to individual users." DISH-1017 at ¶ 15. Such a network is illustrated in Figure 1, where "cells 14 (three in this example), each cell comprising a base station 12 [are] in wireless communication with a plurality of user equipment (UE) or mobile stations (MS) 16." *Id.*, ¶ 16, FIG. 1.

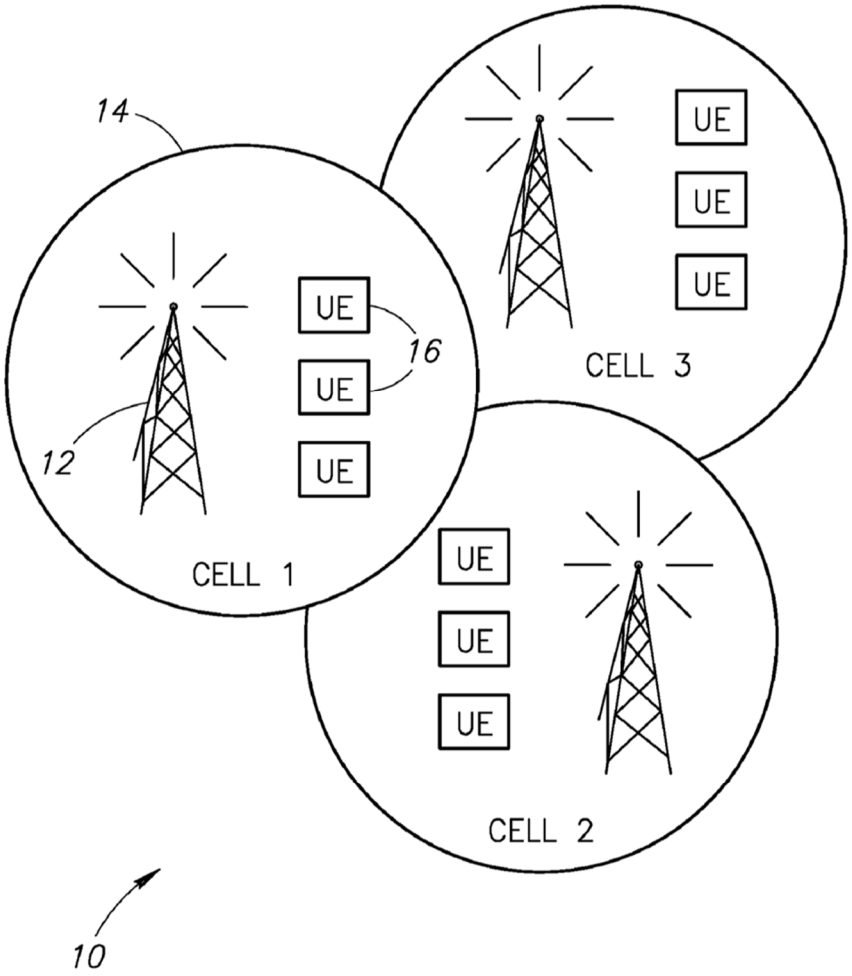


FIG.1
PRIOR ART

FIGURE 1 OF SCHEIM (PRIOR ART)

224. Tzannes similarly teaches "a system and method that scrambles the phase characteristics of the modulated carrier signals in a transmission signal" and that its principles "apply [] to other types of multicarrier modulation, such as . . . [OFDM]." DISH-1009 at 2:20-33, 3:31-51. A POSITA would have understood that Tzannes's techniques apply to subcarriers, particularly because Tzannes

references both carriers and sub-channels and because "phase scrambler 66 determines each value for a carrier signal independently of the QAM symbols 58," as shown in figure 1.

3. Element 1b

> [1b] "b) providing a corresponding element of a pseudorandom noise sequence for each subcarrier of the set of available subcarriers"

225. It is my opinion that Tzannes discloses 1b and that Scheim-Tzannes renders this element obvious.

226. Scheim-Tzannes renders obvious 1b through Tzannes's use of pseudo-random sequences to vary carrier signal phase of OFDMA transmissions.

227. As an initial point, I note that a POSITA would have understood that several synonymous terms can be used to describe a "pseudorandom noise sequence" that appears in element 1b. For example, Tzannes's references to "phase scrambling" and "pseudo-RNG" are references to pseudorandom noise sequences. DISH-1009 at 4:52-67. Additional references use similar labels to describe a "pseudorandom noise sequence." See DISH-1014 (discussing "pseudo noise (PN)" sequences); DISH-1001 at 8:55-59 (identifying "generator polynomial $X^{15}+X+l$" as a "pseudorandom noise sequence"); DISH-1008 at 71 (explaining that "[t]he property of a PN sequence is that the sequence appears to be noise-like if the construction is not known at the receiver.").

228. Tzannes applies pseudorandom sequences to (i.e., when it applies the sequences, it scrambles the signal) the phase component of individual carrier signals "to produce a transmission signal with a reduced PAR." DISH-1009 (Abstract), 2:43-3:2, 3:51-5:16, 6:29-31, FIG. 1.

229. Tzannes explains that when scrambling, "a value is associated with each carrier signal," and that "phase shift is computed for each carrier signal based on the value associated with that carrier signal." *Id.*, 2:47-57.

230. With respect to Figure 1, Tzannes explains that "modulator 46 [red] includes a phase scrambler 66 [green] that combines a phase shift computed for each QAM-modulated carrier signal with the phase characteristic of that carrier signal" and that "phase scrambler 66 can be part of or external to the modulator 46." *Id.*, 4:33-43, FIG. 1.

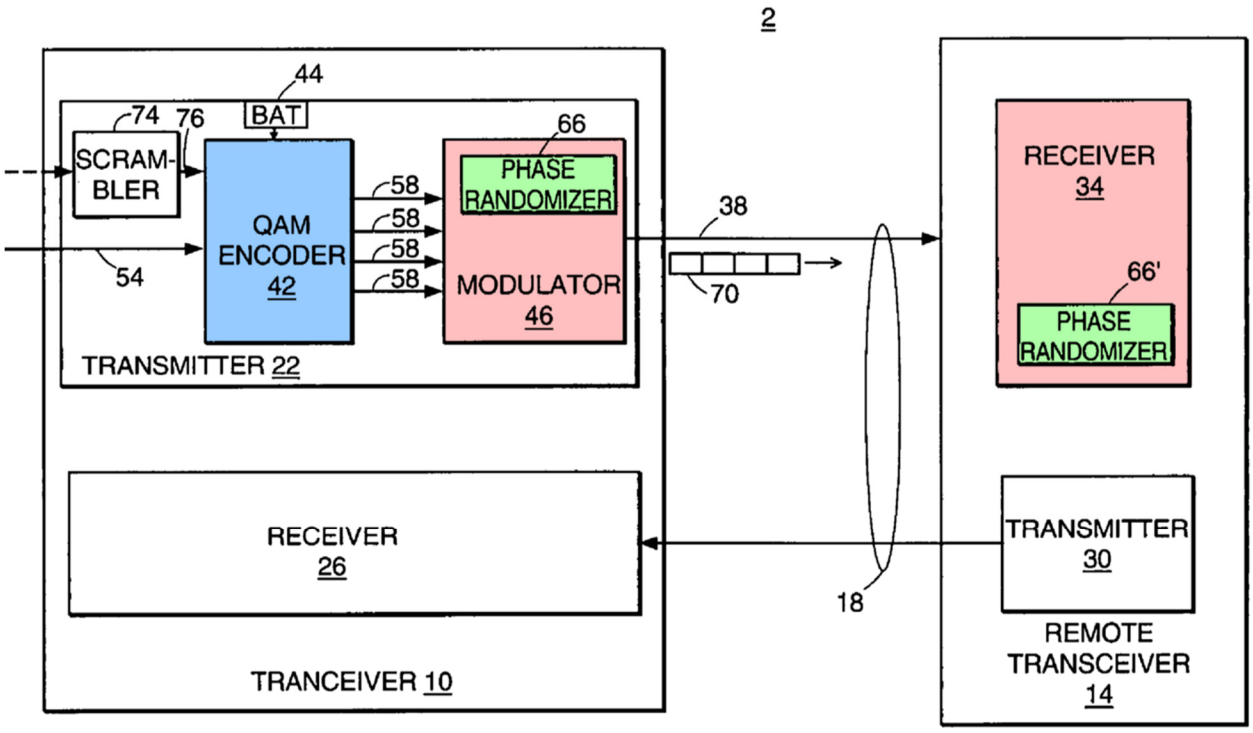


FIG. 1

FIGURE 1 OF TZANNES

231. Tzannes further teaches that "[t]he actual value(s) that the phase scrambler 66 associates with each carrier signal can be derived from one or more predefined parameters, such as a pseudo-random number generator (pseudo-RNG)." *Id.*, 4:52-67, FIG. 1.

232. Tzannes then explains that it "adjust[s] the phase characteristic of each carrier signal" in a DMT system, which is an OFDM system. DISH-1009 5:17-36. A POSITA would have understood that DMT is a wire-based implementation of OFDM.

233. As detailed above, incorporating Tzannes's phase scrambling techniques into Scheim's OFDMA transceiver would have yielded the following transmitter:

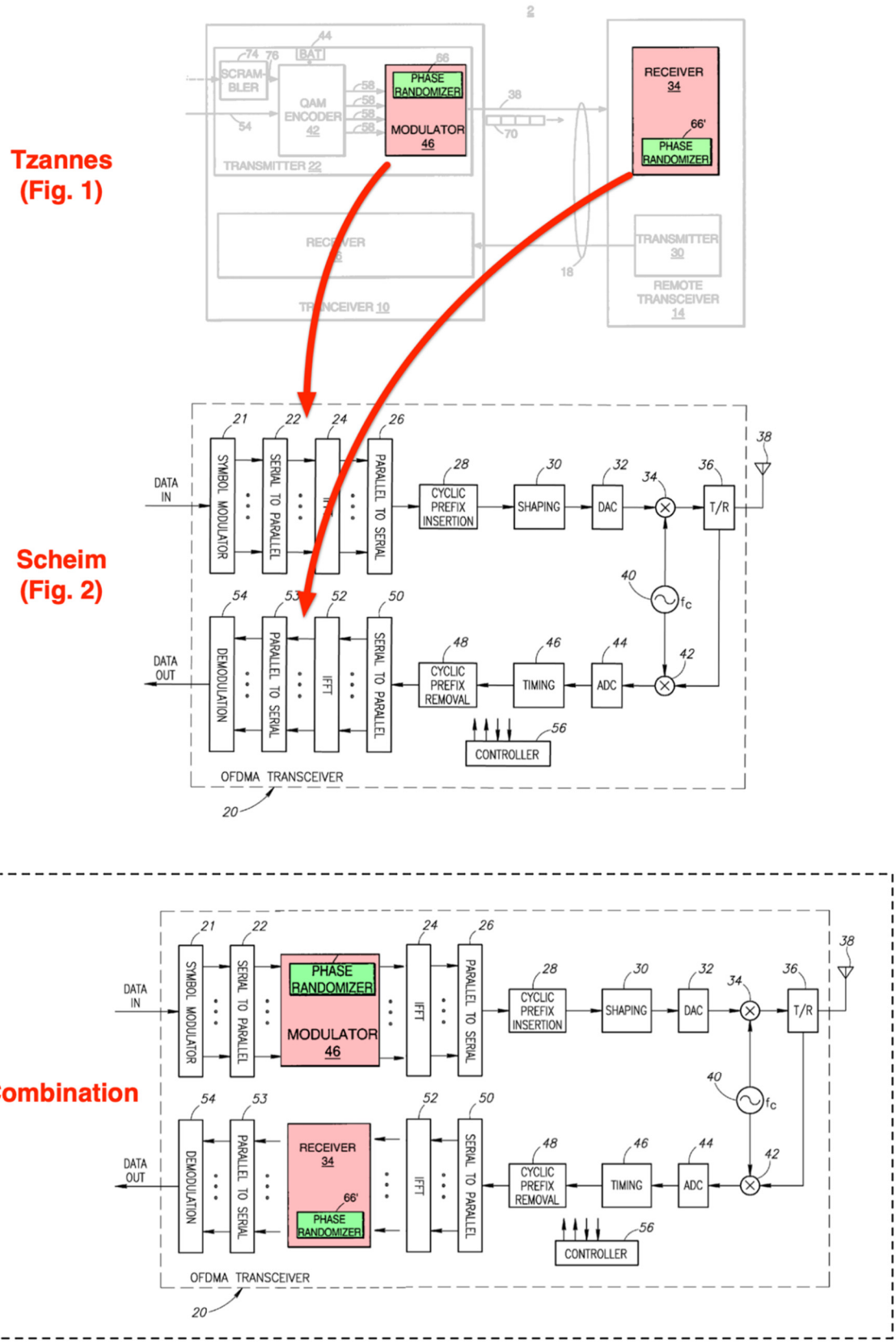


FIGURE 1 OF TZANNES; FIGURE 2 OF SCHEIM; COMBINATION

See § X.C. (Combination of Scheim and Tzannes).

4. Element 1c

[1c] "c) allocating a subset of the set of available subcarriers to each of the transmitting network devices"

234. It is my opinion that Scheim discloses element 1c and that Scheim-Tzannes renders this element obvious.

235. To start, a POSITA would have understood that OFDMA networks allocate a subset of available subcarriers to transmitting devices. For example, the Fazel textbook explains that an OFDMA system "consists of assigning one or several sub-carrier frequencies to each user (terminal station) with the constraint that the sub-carrier spacing is equal to the OFDM frequency spacing 1/Ts." DISH-1008 (Fazel) at 118. Element 1c is merely describing how an OFDMA system works—most, if not all, OFDMA systems disclose or include this element.

236. Scheim is an example of an OFDMA system that discloses this element. In particular, Scheim explains that "[m]ultiple access is achieved in OFDMA by assigning subsets of subcarriers to individual users." DISH-1017 at ¶ 15. In particular, Scheim discloses that a conventional OFDMA frame allocates user IDs ("u-IDs") and resource assignments "R" across the frequency and time domain. DISH-1017 at ¶ 24. Figure 3 (below) illustrates such a conventional frame with five spectral resource allocations (R1 to R5) distributed among five users (u-ID1 to uID5). DISH-1017 at FIG. 3.

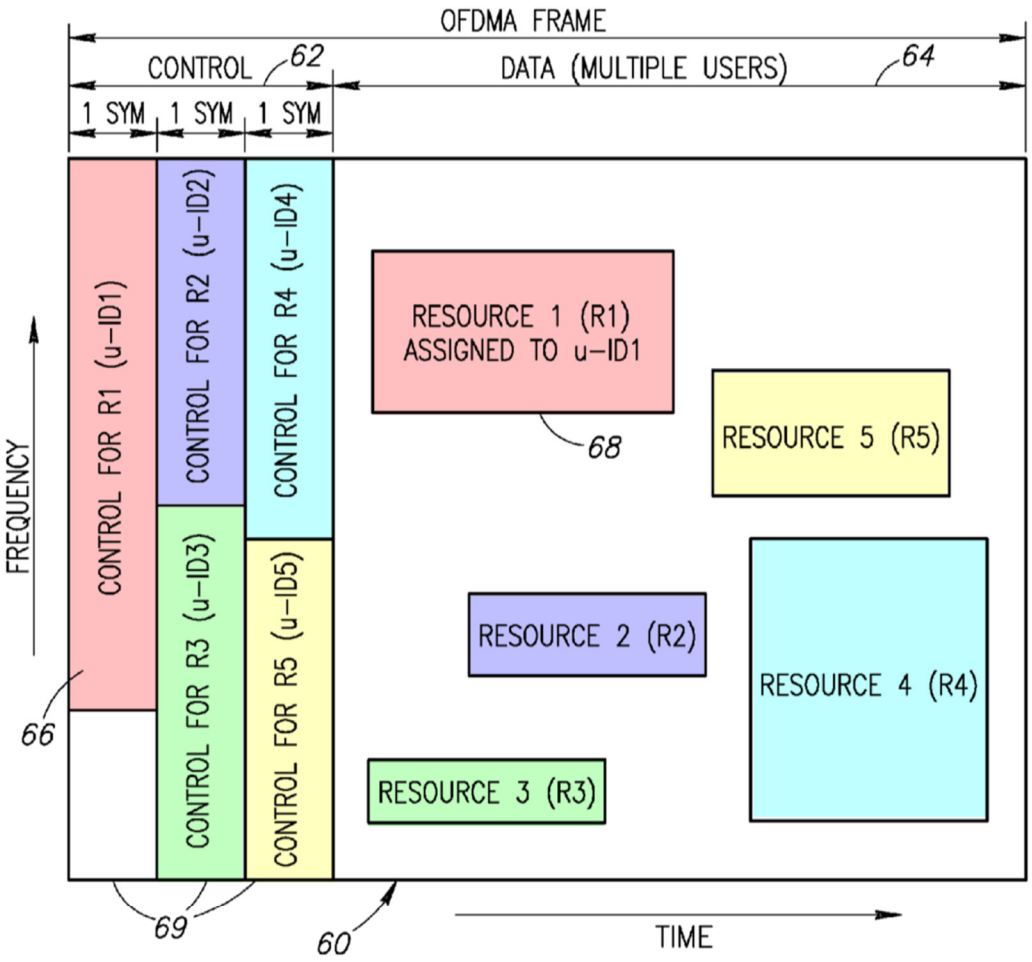


FIG.3
PRIOR ART

FIGURE 3 OF SCHEIM (PRIOR ART)

237. Scheim states that the control message helps users identify the system resources scheduled for the users (i.e., available resources for each of the users). DISH-1017 at ¶¶ 25-26.

5. Element 1d

> [1d] "d) [i] a transmitting network device of the plurality of devices [ii] mapping a packet onto a plurality of used subcarriers of its allocated subset of available subcarriers, wherein the step of mapping the packet comprises [iii] mapping the packet onto a plurality of quadrature amplitude modulated symbols to be transmitted on the used subcarriers"

238. It is my opinion that Scheim and Tzannes each disclose 1d, and that Scheim-Tzannes renders this element obvious.

239. For subpart [1d.i], Scheim discloses "a conventional OFDMA transceiver . . . [that] comprises a transmit path that includes a symbol modulator block 21." DISH-1017 at ¶ 18, FIG. 2. Scheim teaches using quadrature amplitude modulation for the modulation scheme, e.g., the scheme used by the symbol modulator block 21 in Figure 2 below. DISH-1017 at ¶ 11.

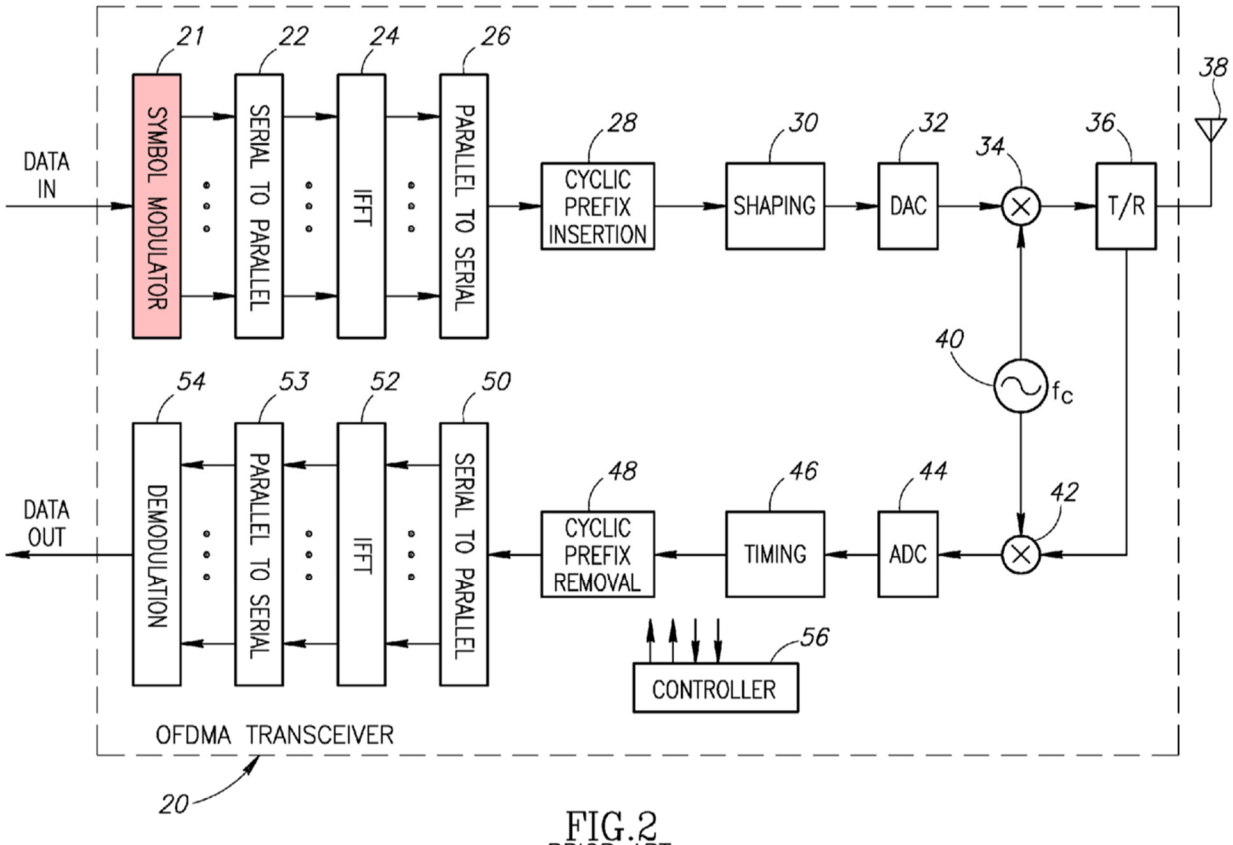


FIG.2
PRIOR ART

FIGURE 2 OF SCHEIM (PRIOR ART)

240. For subpart [1d.ii], Scheim maps a packet by converting a serial signal into multiple parallel signals, e.g., the symbol modulator generates modulated symbols that are mapped onto the assigned resources. DISH-1017 at ¶ 18. For example, the symbol modulator generates modulated symbols that are mapped onto the assigned resources.

241. For subpart [1d.iii], Scheim's subcarriers are subsequently "modulated with a conventional modulation scheme (e.g., quadrature amplitude modulation (QAM))." DISH-1017 at ¶ 11.

242. A POSITA would have understood that the resultant QAM modulated symbols are transmitted on used subcarriers. For example, Fazel explains that in multi-carrier modulation, after mapping, symbols are transmitted over parallel subcarriers. DISH-1008 at 140 (in multi-carrier modulation, "[a]fter symbol mapping (e.g. *M*-QAM) and spreading (in MC-SS), each block of *Nc* complex-valued symbols is serial-to-parallel (S/P) converted and submitted to the multicarrier modulator, where the symbols are transmitted simultaneously on Nc parallel subcarriers, each occupying a small fraction (1/Nc) of the total available bandwidth B.").

243. Separately, Tzannes also discloses element 1d. DISH-1009 at 3:64-4:11, 5:35-58. In my opinion, a POSITA would have reasonably expected to succeed in combining Scheim and Tzannes as described to utilize Scheim's transmitting and mapping functions because Tzannes discloses the same functions recited in element 1d.

244. For subpart [1d.i], Tzannes discloses a transmitter 22 that is a transmitting network device. DISH-1009 at 3:52-54. Further, the transmitter includes a QAM encoder that "has a single input for receiving an input serial data bit stream 54 and multiple parallel outputs to transmit QAM symbols 58 generated by the QAM encoder 42 from the bit stream 54." DISH-1009 at 3:52-67, FIG. 1.

245. For subpart [1d.ii], Tzannes's transmitter maps packets onto subcarriers. DISH-1009 at 4:2-7 ("QAM encoder 42 maps the input serial data bit stream 54 into N parallel quadrature amplitude modulation (QAM) constellation points 58, or QAM symbols 58, where N represents the number of carrier signals generated by the modulator 46."), FIG. 1 (below).

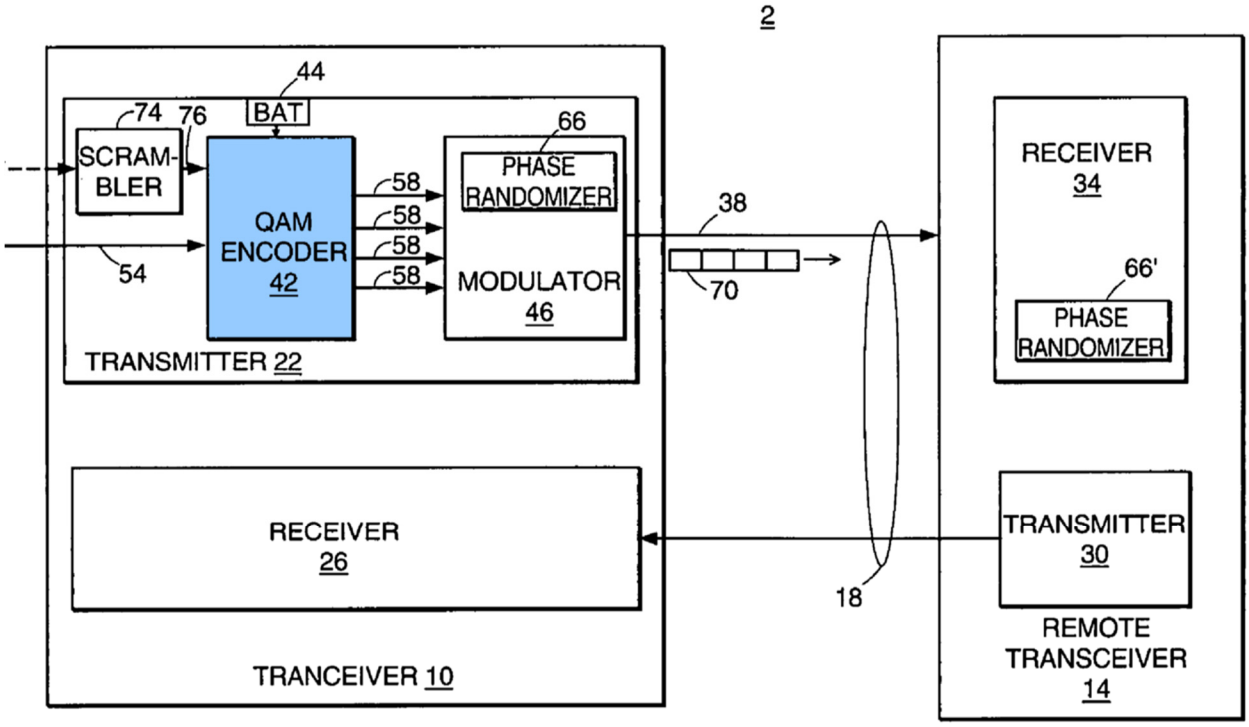


FIG. 1

FIGRURE 1 OF TZANNES

246. For subpart [1d.iii] a POSITA would have understood that the QAM encoder uses QAM symbols to map the packet onto a used subcarrier. DISH-1009 at 3:64-4:11. Fazel teaches this concept in "Multi-Carrier Modulation and Demodulation." DISH-1008 at 140 ("After symbol mapping (e.g. *M*-QAM) and spreading (in MC-SS), each block of *Nc* complex-valued symbols is serial-to-parallel (S/P) converted

and submitted to the multicarrier modulator, where the symbols are transmitted simultaneously on *Nc* parallel subcarriers, each occupying a small fraction (1/*Nc)* of the total available bandwidth *B*.").

247. Thus, Scheim and Tzannes render obvious element 1d.

6. Element 1e

> [1e] "e) the transmitting network device [i] performing a predetermined transformation on a quadrature amplitude modulated symbol [ii] using the element of the pseudorandom noise sequence corresponding to the used subcarrier"

248. It is my opinion that Tzannes discloses element 1e and that Scheim-Tzannes renders this element obvious.

249. Scheim-Tzannes renders obvious 1e through Tzannes's disclosures relating use of pseudo-random sequences to scramble carrier signal phase (with Scheim disclosing the remainder of the element). DISH-1009 at 4:52-54.

250. Tzannes explains that "[t]o compute a phase shift for each carrier signal, the phase scrambler 66 associates one or more values with that carrier signal." DISH-1009 at 4:52-54, FIG. 1. "The phase scrambler 66 determines each value for a carrier signal independently of the QAM symbols 58, and, therefore, independently of the bit value(s) modulated onto the carrier signal." DISH-1017 at 4:54-57, FIG. 1.

251. Tzannes further teaches that "[t]he actual value(s) that the phase scrambler 66 associates with each carrier signal can be derived from one or more predefined parameters, such as a pseudo-random number generator (pseudo-RNG)." DISH-1009 at 4:57-60, FIG. 1 (below). A POSITA would have understood that Tzannes's phase randomizer (66) performs a predetermined transformation.

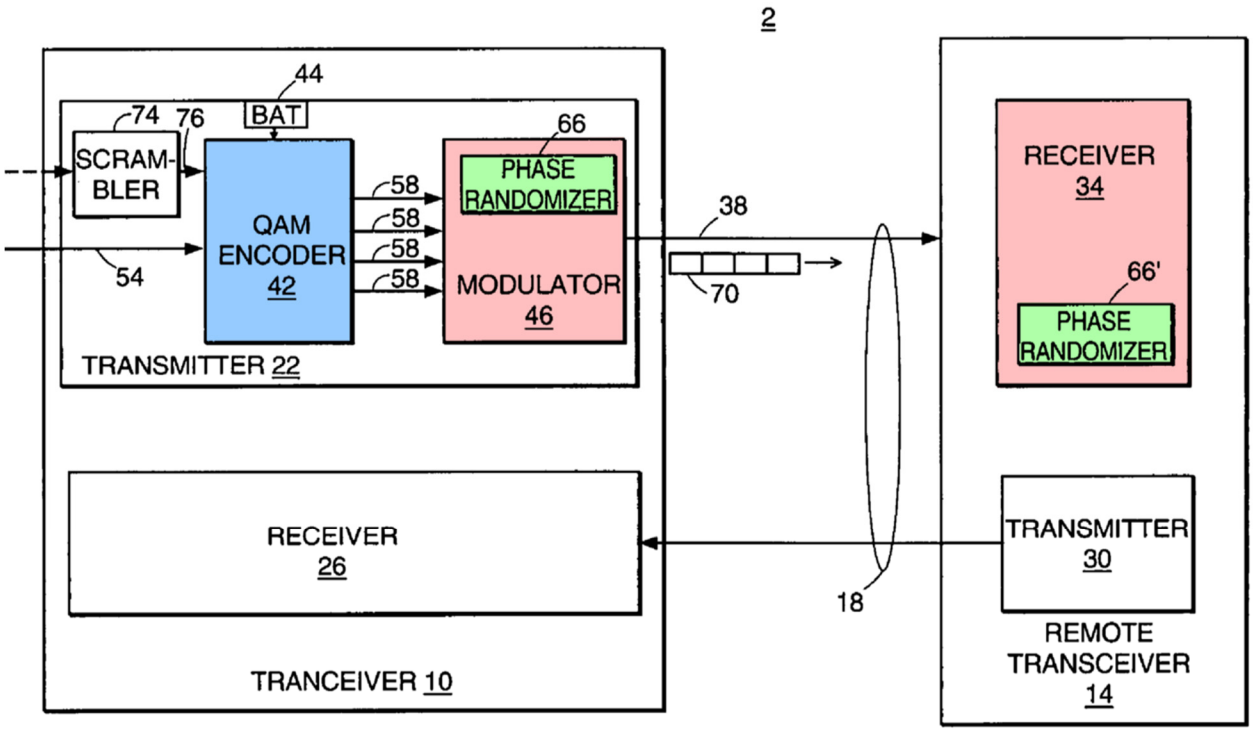


FIG. 1

FIGURE 1 OF TZANNES

252. Tzannes further discloses that "the remote receiver 34 similarly derives the value from the same pseudo-RNG and the same seed as used by the transmitter (i.e., the transmitter pseudo RNG produces the same series of random numbers as the receiver pseudo-RNG)." DISH-1009 at 5:32-36, FIG. 1. A POSITA thus would have understood that Tzannes's disclosure of a receiver that stores data

corresponding to the transmitted PN sequence means that the pseudorandom noise sequence corresponds to the used subcarrier.

253. Further, as explained in Ground 2A (Combination of Scheim and Tzannes) and Ground 2, element 1b, a POSITA would have understood that applying Tzannes's techniques to Scheim would require the simple insertion of a Tzannes's phase scrambler into Scheim's serial-to-parallel block and its IFFT block. The combination is shown below:

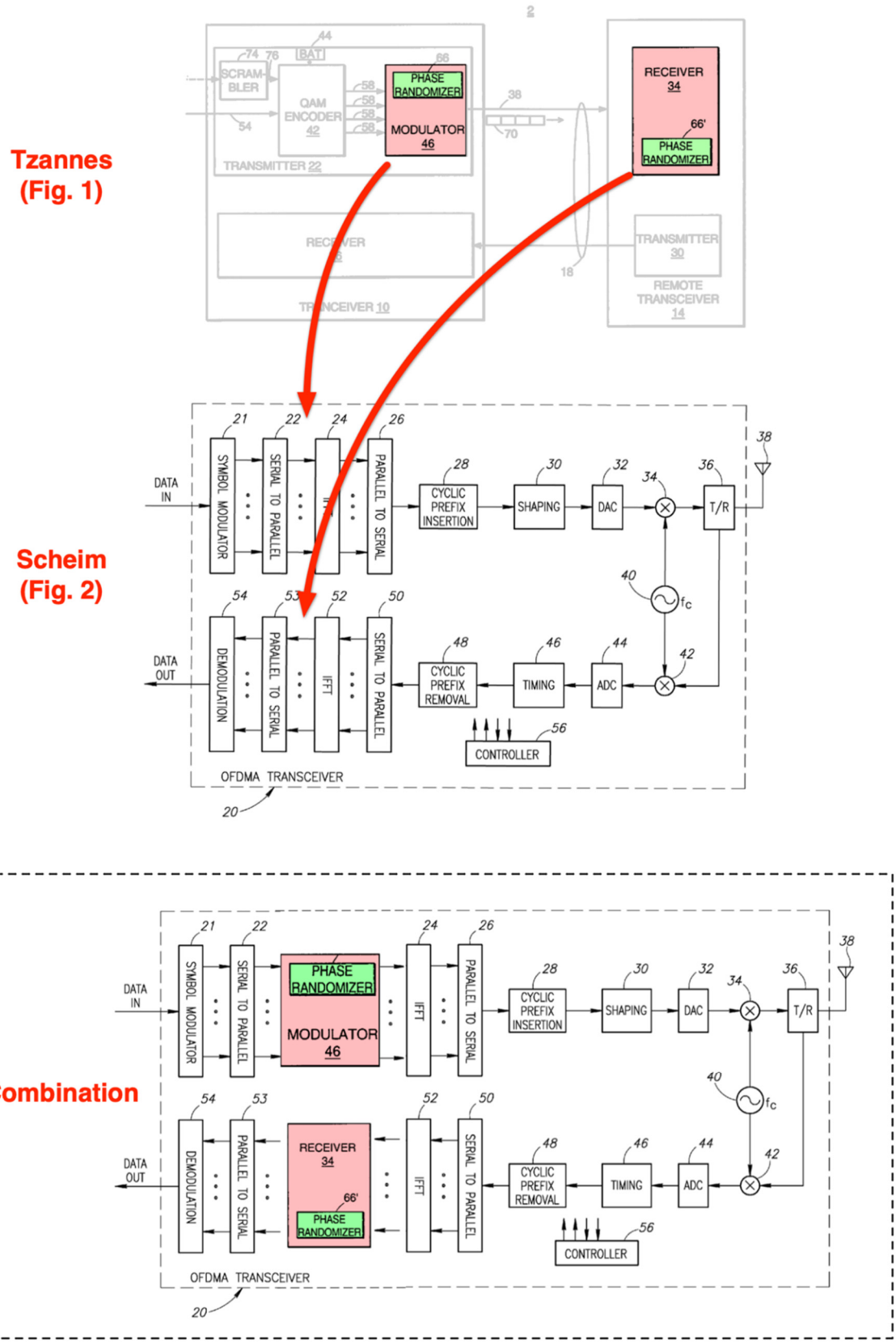


FIGURE 1 OF TZANNES; FIGURE 2 OF SCHEIM; COMBINATION

254. A POSITA would have understood that in Scheim-Tzannes, Tzannes's phase randomizer performs the predetermined transformation on the QAM symbols that come from Scheim's symbol modulator 21 (via serial-to-parallel block 22). With this modification, Scheim would realize Tzannes's benefits of reducing PAR. *Id.*

7. Element 1f

> [1f] "f) the transmitting network device transmitting the transformed symbol to a receiving network device."

255. It is my opinion that Scheim and Tzannes each disclose element 1f and that Scheim-Tzannes renders this element obvious.

256. As an initial matter, a POSITA would have understood that an OFDMA network device transmits a signal that has been processed.

257. Additionally, the transmitters in Scheim's network transmit modulated data symbols and demodulate those symbols at receivers. DISH-1017 at ¶¶ 18, 137.

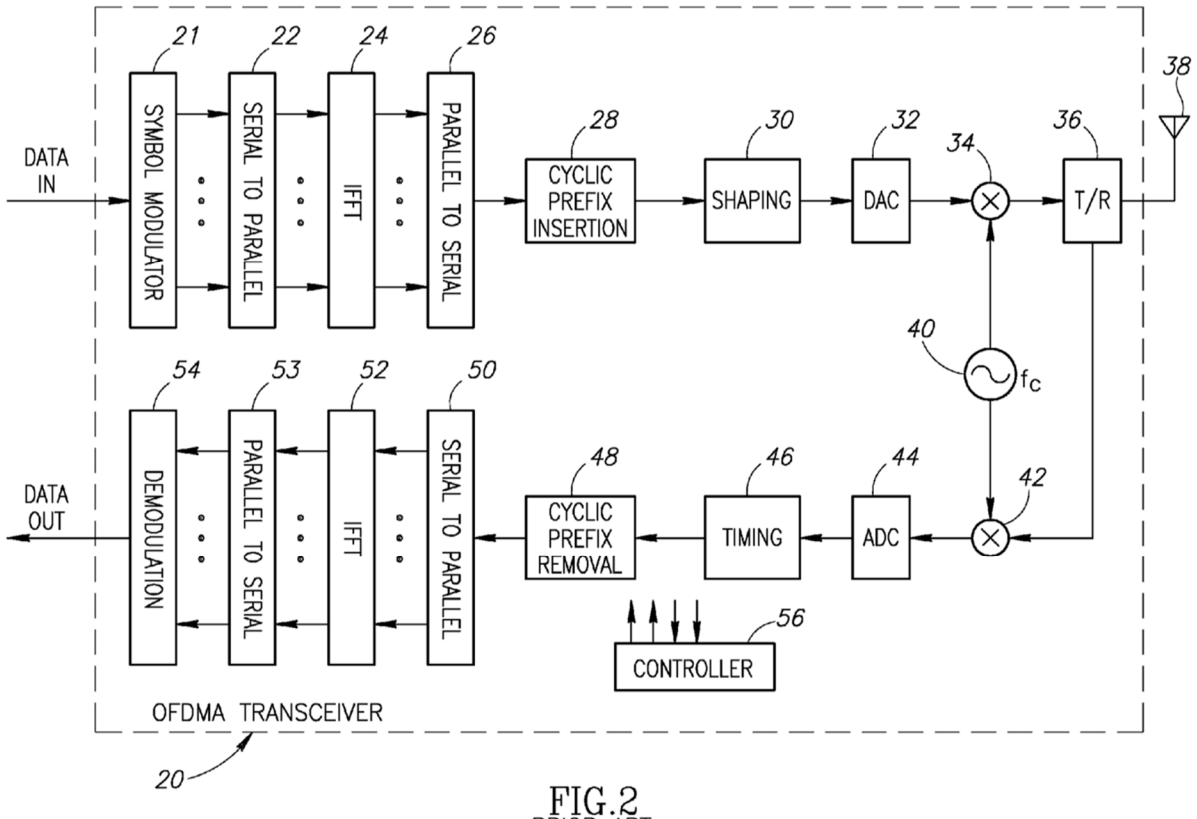


FIG.2
PRIOR ART

FIGURE 2 OF SCHEIM (PRIOR ART)

258. Tzannes similarly discloses a transmitter that transmits transformed symbols. DISH-1009 at 3:24-28, FIG. 1.

259. Accordingly, Scheim-Tzannes renders obvious one of Scheim's transmitters transmitting the transformed symbol to a receiver.

E. Claim 2

1. Preamble

[2pre] "The method of claim 1, wherein the steps of providing a corresponding element of a pseudorandom noise sequence and performing a predetermined transformation comprise:"

260. I have been asked to consider whether the combination of Scheim and Tzannes renders obvious the preamble of claim 2, but I have not been asked to render an opinion on whether the preamble should be considered a limitation. If the preamble of claim 2 is deemed to be a limitation, it is my opinion that the Scheim-Tzannes combination teaches and renders obvious the preamble for the reasons discussed under Ground 2, elements 1b, 1e, 2a, and 2b.

2. Element 2a

> [2a] "a) the transmitting network device [i] receiving an initial pseudorandom noise sequence element from a pseudorandom noise sequence generator, [ii] the initial pseudorandom noise sequence element corresponding to a first available subcarrier and [iii] transforming the symbol to be transmitted on the first available subcarrier if the first available subcarrier is a used subcarrier; and"

261. It is my opinion that Tzannes discloses element 2a and that Scheim-Tzannes renders this element obvious.

262. As discussed in Ground 2, element 1e, a POSITA would have understood that when Tzannes's PN sequence elements are used to modulate particular data symbols, they correspond to the used subcarrier. DISH-1009 at 4:33-67, 6:1-17 ("the pseudo-RNG generates a new random value for each carrier signal"), 6:22-23, FIGS. 1, 2.

263. Tzannes also discloses that each unique random value is used to transform a corresponding used subcarrier (e.g., the initial pseudorandom noise sequence

element corresponding to a first available subcarrier and transforming the symbol to be transmitted on the first available subcarrier). DISH-1009 at 7:50-8:8.[8]

3. Element 2b

> [2b] "b) the transmitting network device advancing the pseudorandom noise generator to receive a next element of the pseudorandom noise sequence corresponding to a next available subcarrier and transforming the symbol to be transmitted on the next available subcarrier if the next available subcarrier is a used subcarrier."

264. It is my opinion that Scheim and Tzannes disclose element 2b and that Scheim-Tzannes renders this element obvious.

265. As discussed in Ground 2, elements 1e and 2a, Scheim and Tzannes teach or render obvious PN sequence elements that correspond to used subcarriers, and that the PN sequences advance to generate a next unique random value (i.e., element) for the next available subcarrier.

F. Claim 3

> [3] "The method of claim 2, wherein the step of the transmitting network device advancing the pseudorandom noise generator is repeated until a symbol to be transmitted on a last used subcarrier is transformed."

266. It is my opinion that Scheim-Tzannes renders claim 3 obvious.

267. A POSITA would be aware of many methods to generate PN sequences.

[8] Scheim describes how a pseudo-random number generator (pseudo-RNG), such as the one used in Tzannes, works. See DISH-1017 at ¶¶ 111-113.

268. Figure 11 of the ‘566 patent describes one method, which employs “shift register 370” such that “[w]hen the sequence generator is clocked, the shift register generates a new A_{14} as A_0+A_1, discards the bit in A, movies [sic] each bit from A_n to A_{n-1}.” DISH-1001 at 8:55-9:9, FIG. 11.

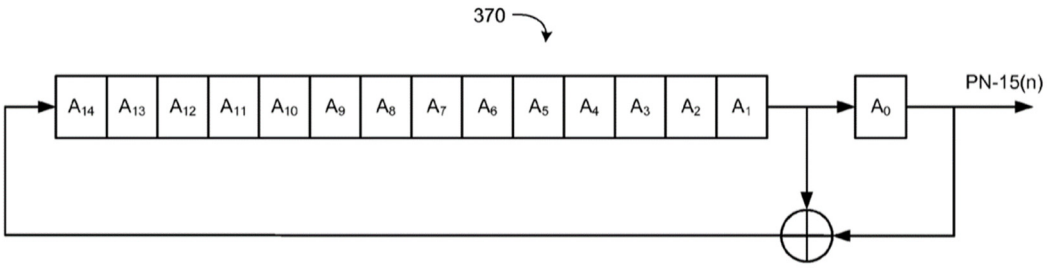


Fig. 11

FIGURE 11 OF THE ’566 PATENT

269. A POSITA would have recognized shift register 370 as a linear feedback shift register and that using shift registers to generate and advance PN series noise sequences was well known. For example, Mutagi discloses the use of “[p]seudo random binary sequences (PRBSs), also known as pseudo noise (PN) [or] linear feedback shift register (LFSR) sequences” in OFDM communications. DISH-1014 at 79-80.

270. Similarly, Gupta and Vijayan disclose OFDM communication systems that utilize “PN generator 1620 . . . with a 15-tap linear feedback shift register (LFSR).” DISH-1012 at 17:17-20; DISH-1013 at 7:21-23.

271. As discussed in Ground 2, elements 1b, 1e, 2a, and 2b, Tzannes disclose advancing a pseudorandom noise generator in teach that "[t]o compute a phase shift for each carrier signal, . . . phase scrambler 66 determines each value for a carrier signal independently of the QAM symbols 58, and, therefore, independently of the bit value(s) modulated onto the carrier signal." DISH-1009 at 4:52-67.

272. A POSITA would have understood that Tzannes's phase scrambler could be a LFSR. DISH-1009 at 4:42-48. Additionally, a POSITA would have understood that Tzannes's PN sequences are advanced until a symbol to be transmitted on a last used subcarrier is transformed. DISH-1009 4:54-55 ("The phase scrambler 66 determines each value for a carrier signal independently of the QAM symbols 58").

XI. GROUND 2B: SCHEIM-TZANNES IN VIEW OF MUTAGI

A. Scheim-Tzannes in view of Mutagi

273. As discussed above in Ground 1B, Mutagi demonstrates that PN sequences were well known in digital communications. See § VII(A) (Overview of Mutagi). That discussion applies equally to Scheim-Tzannes, because each reference (Cleveland, Hayashino, Scheim, and Tzannes) is directed to OFDM/OFDMA.

B. Claim 4

> [4] "The method of claim 1, wherein the pseudorandom noise sequence comprises a PN-15 sequence."

274. It is my opinion that Scheim-Tzannes, particularly in view of a POSITA's background knowledge, renders claim 4 obvious. Mutagi is representative of a POSITA's background knowledge.

275. As discussed above, Tzannes's scrambler generates a pseudorandom sequence. DISH-1009 at 4:52-67, 6:13-28. Mutagi discloses 24 PN sequences, and it specifically discloses "a 15 bit PN sequence" throughout its discussion. DISH-1014 at 80, FIG. 1. Because Mutagi discloses many PN sequences including a PN-15 sequence, and because a POSITA would have found it obvious to try using any of those sequences, a POSITA would have found claim 4 obvious.

XII. GROUND 2C: SCHEIM-TZANNES IN VIEW OF MUTAGI AND TING

A. Scheim-Tzannes in view of Mutagi and Ting

276. A POSITA would have been motivated to increase the randomization in pilot signals in Scheim-Tzannes-Mutagi's network to decrease the potential interference in the network further. Further, because pilot signals are critically important to system operation because they are used to establish a link between a transmitter and receiver, as well as to synchronize the transmitter and receiver. Given these functions, a POSITA would have been motivated to ensure that the pilot signal is not lost due to interreference.

277. To avoid this problem, a POSITA would have been motivated to use an approach like Ting's, which helps ensure that network devices receive the appropriate pilot signals. In this respect, applying Ting's teachings improves Scheim-Tzannes with respect to pilot signals.

B. Claim 5

> [5] "The method of claim 4, wherein the step of performing the predetermined transformation comprises rotating the quadrature amplitude modulated symbol by 180° if the element of the pseudorandom noise sequence is a '1' and not modifying the quadrature amplitude modulated symbol if the element of the pseudorandom noise sequence is a '0'."

278. It is my opinion that that Ting discloses the subject matter of claim 5 and that Scheim-Tzannes, in view of Mutagi and Ting, renders claim 5 obvious.

279. Ting teaches multiplying pilot symbols by this factor:

$$\mathbf{2} \times (\frac{\mathbf{1}}{\mathbf{2}} - \boldsymbol{W_k})$$

DISH-1015 at 23-24.

280. As a POSITA would have understood, when a bit stream is multiplied by Ting's factor, the resultant product rotates a "1" to a "-1" and a "0" to a "1", which rotates the symbol (on a QAM constellation) by 180°.

XIII. GROUND 2D: SCHEIM-TZANNES IN VIEW OF MUTAGI AND OHANA

A. Scheim-Tzannes in view of Mutagi and Ohana

281. As discussed above, a POSITA would have understood that Ohana discloses known components in a coordinated network—i.e., network coordinators and reservation requests. See § IX (Ground 1D).

282. In the 2000's, wireless customers were demanding increased data speeds. DISH-1008, 10 ("The demand for high data rate wireless multi-media applications has increased significantly in the past few years.").

283. A POSITA looking to increase data speeds on Scheim-Tzannes's network would have been motivated to use Ohana's persistent reservation requests because they reduce reservation-request latency. DISH-1016 at ¶¶ 13, 15, 29. Further, a POSITA would have had a reasonable expectation of success in using Ohana's persistent reservation requests in Scheim-Tzannes, because implementing the p-RR's would have been an exercise of ordinary skill.

B. Claim 6

> [6] "The method of claim 4, wherein the receiving network device comprises a network coordinator and wherein the packet comprises a resource reservation request packet."

284. It is my opinion that Scheim-Tzannes, in view of Mutagi and Ohana, renders claim 6 obvious.

285. A network coordinator (NC) is a device in a multi-device system that "allocate[s] network bandwidth" among the devices. DISH-1001 at 4:35-46. In coaxial home networks, this is performed by allowing "network devices to transmit a Reservation Request[s] (RR) . . . for a certain amount of bandwidth at a certain time." *Id*. The '566 patent explains that "[t]he required time to receive these RRs grows with the size of the network." *Id*., 4:46-48.

286. Ohana Figure 4 discloses a network 400 that includes a network coordinator 408:

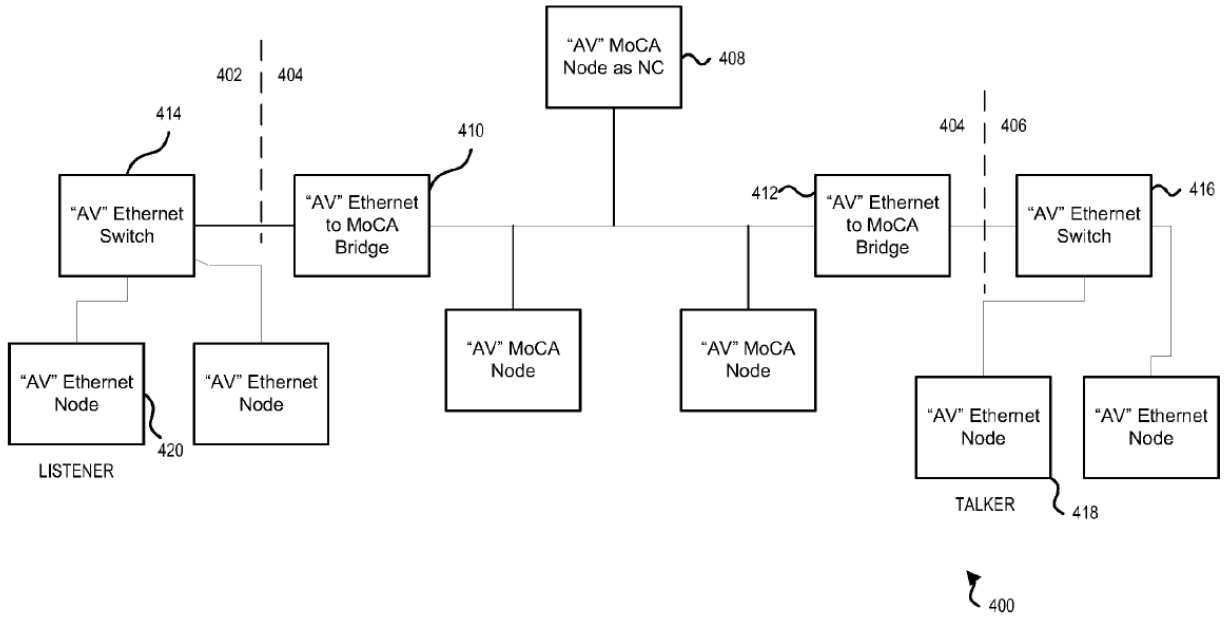


FIGURE 4 OF OHANA

DISH-1016 at ¶ 41. Ohana's network uses persistent reservation requests ("p-RR") that "request allocation of network resources for transmitting the data.

DISH-1016 at ¶¶ 29-30. Ohana thus discloses claim 6's network coordinator and reservation requests.

C. Claim 12

> [12] "The method of claim 4, wherein the method is performed by a network coordinator and wherein first and second scrambled orthogonal frequency division modulation symbols are contained in a resource reservation request packet.

287. It is my opinion that Scheim-Tzannes, in view of Mutagi and Ohana, renders claim 12 obvious based on the analysis presented above.

288. A POSITA would have found it obvious to include a scrambled OFDMA symbol in a resource reservation request packet because multiplexed systems, such as OFDM/OFDMA and ADSL, typically deliver reservation requests over multiple subchannels, which requires using at least two scrambled orthogonal frequency division modulation symbols. DISH-1016 at ¶ 8. Additionally, including the scrambled OFDMA symbol in a resource reservation request lowers PAR across the network. In this respect, a POSITA would have been motivated to use Cleveland-Hayashino's approach in reservation requests, to realize Cleveland-Hayashino's benefits across the network's entire operation.

XIV. RESERVATIONS

289. If I am called to testify at the hearing, I may rely on demonstrative exhibits that illustrate and help explain the bases of my opinions (including those presented above).

290. I am not aware of any secondary-considerations evidence concerning the challenged claims. To the extent that I become aware of any evidence of secondary considerations of non-obviousness concerning the challenged claims, I reserve my right to revise or supplement my opinions to address or respond to such evidence.

291. Other than as provided or referenced in this declaration, I have not yet prepared any exhibits to support my opinions.

292. If new information becomes available, or new arguments are presented, I may revise or supplement my analysis.

[Conclusion follows on next page]

XV. CONCLUSION

293. For the reasons discussed above, in my opinion a person of ordinary skill in the art would have found claims 1-6 and 12 of the ’566 patent obvious over the references presented in Ground 1.

294. Likewise, for the reasons discussed above, in my opinion a person of ordinary skill in the art would have found claims 1-6 and 12 of the ’566 patent obvious over the references presented in Ground 2.

295. I declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true. I also declare 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 18 U.S.C. § 1001. I declare under the penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Date: February 7, 2024

Tim A. Williams, Ph.D.

APPENDIX A

Tim Arthur Williams, Ph.D.
Curriculum Vitae

Dr. Williams has 45 years of professional experience in wireless communications, networking and telecom technology. He is an entrepreneur who has participated in the organization and operation of start up companies that brought wireless LAN, software VoIP PBX, and 2-way paging technology to the marketplace. Dr. Williams holds numerous patents in wireless and signal processing technology. He is an experienced litigation support consultant with experience in patent infringement matters. Dr. Williams is also a registered Patent Agent.

- Wireless LAN
- Cellular and PCS Standards
- Cellular Telephone Architecture
- Digital Signal Processing
- Telecommunications Technology
- VoIP Technology
- Computer Networking
- Wireless Networks & Protocols

Year	University	Degree
1991	University of Texas at Austin	MBA
1985	University of Texas at Austin	Ph.D., Dissertation: "Digital Signal Processing Techniques for Acoustic Log Data"
1982	University of Texas at Austin	MSEE, Thesis: "Cepstral Processing of Speech Signals"
1976	Michigan Technological University	BSEE

Professional Experience

From: 2008
To: 2010
Organization: Expressume, Inc / Montage Inc. – Milwaukee, WI
Title: Board Member
Summary: This company sells software for human resource recruiting. This company was sold in June 2019.

From: 2008
To: 2014
Organization: Faculte, Inc. – San Jose, CA
Title: Board Member
Summary: This company provided SaaS (Software as a Service) web video based communication products.

From: 2008
To: 2010
Organization: BitRail Networks Inc. – Miami, FL
Title: Founder, Board Member
Summary: This company sold computer networking solutions.

From: 2008
To: Present
Organization: Calumet Venture Management – Madison, WI
Title: Member
Summary: This company provides seed capital and management expertise to small companies.

From: 2006
To: 2015
Organization: BEEcube Inc. – Fremont, CA
Title: Founder, Board Member, Board Advisor
Summary: This company built high speed processing solutions. This company was sold to National Instruments, Inc. in Feb 2015.

From:	2006
To:	2015
Organization:	Topaz Equity, LLC – Danville, CA
Title:	Founder, Board Member
Summary:	This is a private equity investment company. It owned AtomAMPD which develops, markets and sells software based network solutions.

From:	2004
To:	Present
Organization:	DoceoTech Inc. – Danville, CA
Title:	Founder, Chairman
Summary:	This was a training company that provides training for engineers in Wireless, Networking, and Telephony technologies. It is currently owned by Beach Technologies, LLC.

From:	2004
To:	2006
Organization:	SiBEAM, Inc. – Sunnyvale, CA
Title:	Founder, Chief Executive Officer
Summary:	This is a fabless semiconductor company that develops high-speed wireless networking ICs. This company was sold to Silicon Image, Inc. in Apr 2011.

From:	2001
To:	2004
Organization:	JetQue, Inc. – Danville, CA
Title:	Founder, Chief Executive Officer
Summary:	This company created messaging solutions for the mobile professional.

From:	1999
To:	2000
Organization:	Atheros Communications, Palo Alto, CA
Title:	Interim CEO, Advisory Board Member
Summary:	This company builds wireless LAN ICs. Atheros became a public company in May 2004. (ATHR) This company was sold to QCOM in Jan 2011.

From: 1998
To: 2000
Organization: Picazo Communications, Inc. – San Jose, CA
Title: Chief Technology Officer, Advisory Board Member
Summary: This company built and sold software PBXs Telephony equipment using VoIP and Circuit Switched Technologies. The company was purchased by Intel.

From: 1996
To: Present
Organization: Beach Technologies, LLC – Danville, CA
Title: Chief Executive Officer
Summary: This is a consulting company that provides IP services. It owns DoceoTech LLC and Streaming Knowledge LLC, which perform the same services.

From: 1991
To: 1998
Organization: Wireless Access, Inc. – Santa Clara, CA
Title: Co-Founder, Chief Technical Officer, Vice President of Engineering, Vice President of Business Strategy
Summary: This was a startup company focusing on the Narrow Band PCS equipment market. The company developed the over the air protocols, the subscriber equipment and the ICs to deploy 2-way paging services. The company was sold to Glenarye Electronics.

From: 2014
To: 2021
Organization: Through Technology, LLC. – Chicago, IL
Title: Partner
Summary: This is a private equity investment company. It owns Through Technology Group, PTE LTD, which is registered in Singapore.

From: 1979
To: 1991
Organization: Motorola, Inc. – Austin, TX – Semiconductor Sector

Title: Sr. Engineer, Member Technical Staff, Sr. MTS

Summary: Business manager, project leader, and senior technical member of the teams which were responsible for product development of the following systems:

- ADPCM transcoder,
- ISDN U-reference point transceiver,
- CT-2 voice codec and channel modem,
- GSM voice codec and channel modem,
- TDMA voice codec and channel modem
- CDMA voice codec and channel modem, and
- Japanese Digital Cellular voice codec and channel modem.

From: 1976

To: 1979

Organization: Motorola Inc. - Chicago, IL - Communications Sector - Digital Voice Privacy Group

Title: Engineer

Summary: This group built the first commercial digitally encrypted two-way FM land mobile radio system.

Professional Certifications

- Patent Agent – U.S. Patent and Trademark Office #50,790 (Jan 2002)

Issued Patents

Patent	Date	Description
9,787,471	2017	Data Enciphering or Deciphering using a Hierarchical Assignment System
7,904,117	2011	Wireless Communication Device using Adaptive Beamforming
6,781,962	2004	Apparatus and Method for Stored Voice Message Control
6,600,481	2003	Data entry apparatus and method
6,088,457	2000	Method and apparatus for over the air programming a communication device
5,854,595	1998	Communications apparatus and method with a computer interchangeable integrated circuit card
5,557,642	1996	Direct conversion receiver for multiple protocols

5,428,638	1995	Method and apparatus for reducing power consumption in digital communications devices
5,345,406	1994	Bandpass sigma delta converter suitable for multiple protocols
5,101,344	1992	Data processor having split level control store
5,001,661	1991	Data processor with combined adaptive LMS and general multiplication functions
4,989,169	1991	Digital tone detector using a ratio of two demodulators of differing frequency
4,972,356	1990	Systolic IIR decimation filter
4,965,762	1990	Mixed size radix recoded multiplier
4,947,363	1990	Pipelined processor for implementing the least-mean-squares algorithm
4,876,542	1989	Multiple output oversampling A/D converter with each output containing data and noise
4,862,169	1989	Oversampled A/D converter using filtered, cascaded noise shaping modulators
4,843,585	1989	Pipelineable structure for efficient multiplication and accumulation operations
4,843,390	1989	Oversampled A/D converter having digital error correction
4,796,219	1989	Serial two's complement multiplier
4,737,925	1988	Method and apparatus for minimizing a memory table for use with nonlinear monotonic arithmetic functions
4,734,876	1988	Circuit for selecting one of a plurality of exponential values to a predetermined base to provide a maximum value
4,727,508	1988	Circuit for adding and/or subtracting numbers in logarithmic representation
4,722,067	1988	Method and apparatus for implementing modulo arithmetic calculations
4,682,302	1987	Logarithmic arithmetic logic unit
4,618,946	1986	Dual page memory system having storage elements which are selectively swapped between the pages
4,406,010	1983	Receiver for CVSD modulation with integral filtering
4,398,262	1983	Time multiplexed n-ordered digital filter

Patent Applications and Continuation Applications

Appl. Num.	Pub. Date	Description
20070037528	2007	Wireless Communication Device using Adaptive Beamforming
20040252679	2004	Stored Voice message Control Extensions
15/711,590	2017	Data Enciphering or Deciphering using a Hierarchical Assignment

Published Papers

6 Sept 2016 Putnam, Jonathan D. and Williams, Tim A., The Smallest Salable Patent-Practicing Unit (SSPPU): Theory and Evidence.
Available at SSRN: https://ssrn.com/abstract=2835617

19 Sept 2022 Williams, Tim A, A Study of IPlytics Standard Essential Patent Tool.
Available at SSRN: https://ssrn.com/abstract= 4223782

Litigation Experience

See attached.

Dr Tim A Williams Case History

Case Type	Firm	Case Name	Client	Status	Deposition	Trial Testimc	Enagement L	Venue	Case Number(s)
Patent Infringement wireless LANs	Morgan Miller and Blair	Proxim v. 3Com	3Com.	Complete			2001	D. Del.	1:2001-cv-00155; 1:2001-cv-00755
Patent Infringement Networking ICs	Simpson Thacher & Bartlett LLP	3Com Inc. v. D-Link/ Realtek Inc.	3Com	Complete			2002	N.D. CA	03-cv-02177
Patent Infringement Wireless LANs	Weil Gotshal & Manges	Agere Systems v. Broadcom Inc.	Broadcom	Complete			2003	E.D. PA	03-cv-03138
Patent Infringement Digital Subscriber Loop (DSL)	Heller Ehrman White & McAuliffe	GlobespanVirata v. Texas Instruments	Texas Instruments; Stanford University	Complete	Y	Y	2003	D.N.J.	03-cv-02854
Patent Infringement Cellular Phones	McKool Smith	Ericsson Inc v. Samsung Inc.	Ericsson	Complete	Y		2004	ITC	337-TA-577
Patent Infringement PBX services	Howrey	Foundry Networks v. Alcatel Inc.	Foundry Networks	Complete			2004	E.D. TX	2:04-cv-00040
Patent Infringement PBX services	Howrey	Foundry Networks v. Lucent Technologies Inc.	Foundry Networks	Complete	Y		2004	E.D. TX	2:04-cv-00040
Patent Infringement Wireless ICs	Kirkland and Ellis LLP	Intel Corp. v. Wi-LAN Inc.	Intel	Complete			2004	N.D. CA	08-cv-04555
Patent Infringement VoIP Recording	Fish and Richardson	STS Networks v. Witness Systems	Witness Systems	Complete	Y	Y	2004	N.D. Ga.	04-cv-02111
Patent Infringement Telephone Systems	Sidley Austin LLP	C2 Comm. Tech Inc. v. AT&T Inc.	AT&T	Complete			2006	E.D. TX	2:06-cv-00241
Patent Infringement Networking ICs	Simpson Thacher & Bartlett LLP	Commil USA LLC v. Cisco Systems Inc.	Cisco	Complete			2006	E.D. TX	2:07-cv-341; 2:11-cv-00417; 2:11-cv-00265
Patent Infringement PBX services	Fish and Richardson	Microsoft Inc. v. Alcatel Inc.	Microsoft	Complete			2006	ITC	337-TA-598

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Case Type	Firm	Case Name	Client	Status	Deposition	Trial Testimc	Enagement L	Venue	Case Number(s)
Patent Infringement and Trade Secret Cellular Phones	Heller Ehrman White & McAuliffe	Qualcomm Inc v. Broadcom Inc.	Qualcomm	Complete			2006	S.D. CA	06-cv-0660
Patent Infringement Telephone Systems	Jones Day LLP	in re Katz Patents	Experian	Complete			2007	C.D. CA	07-ml-01816
Patent Infringement Telephone Systems	Howrey	in re Katz Patents	General Electric	Complete	Y		2007	C.D. CA	07-ml-01816
Patent Infringement Wireless Networks	Heller Ehrman LLP and Covington & Burling LLP	Intermec Tech. V. Palm Inc.	Palm	Complete	Y		2007	D. Del.	1:2007-cv-00272
Patent Infringement Cellular Phones	Cooley Godward Kronish LLP	Qualcomm Inc. v. Broadcom Inc.	Qualcomm	Complete			2007	S.D. CA	08-cv-01607; 08-cv-01829_
Patent Infringement Cellular Phones	DLA Piper	Qualcomm Inc. v. Nokia Inc.	Qualcomm	Complete			2007	W.D. WI; S.D. CA; S.D. CA	3:07-cv-00187; 3:07-cv-01366; 3:05-cv-02063
Patent Infringement	Howrey LLP	Minerva Inc. v Motorola Inc. et al.	Research in Motion	Complete			2007	E.D. TX	2:2007-cv-00229
Patent Infringement	Covington & Burling; Cooley; Howrey; DLA Piper	Saxon Innovations LLC. v. Nokia Corp. et al.	Samsung; Nintento; RIM; Palm	Complete			2007	E.D. TX	6:2007-cv-00490
Patent Infringement	Baker Botts LLP	AT&T v Airbiquity	AT&T	Complete			2008	N.D. TX	08-cv-01637
Patent Infringement	Quinn Emanuel LLP	ESN v Cisco	Cisco	Complete			2008	E.D. TX	5:08-cv-00020
Patent Infringement Telephone Call Processing	Jones Day LLP	in re Katz Interactive Call Processing	Citizens Communicati ons	Complete	Y		2008	C.D. CA	07-ml-01816

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Case Type	Firm	Case Name	Client	Status	Deposition	Trial Testimc	Enagement L	Venue	Case Number(s)
Patent Infringement VoIP	Kilpatrick Stockton LLP	Verizon Corp. v. Cox Inc.	Cox	Complete	Y	Y	2008	E.D. VA	1:08-cv-00157
Patent Infringement	Latham & Watkins LLP	Freedom Wireless Inc. v. Cricket Communications Inc et al.	Cricket Comm.	Complete	Y		2008	E.D. TX	2:06-CV-504
Patent Infringement	Irell & Manella LLP	eBay Inc. v. IDT Corp. et al.	eBay.	Complete	Y		2008	W.D. AR	4:08-cv-04015
Patent Infringement	Foley & Lardner LLP	SPH America LLC v. Kyocera Wireless Corp. et al.	Kyocera.	Complete			2008	S.D. CA	3:08-cv-02146; 3:09-cv-00299; 3:09-cv-00572
Patent Infringement Wireless Devices	Ropes & Grey LLP	Motorola Inc. v. Research in Motion Inc.	Motorola	Complete			2008	N.D. TX	3:08-cv-00284
Patent Infringement	Banner & Witcoff	Paradox Ltd. v. ADT Ltd.	Paradox	Complete	Y		2008	E.D. TX	2:06-cv-00462
Patent Infringement	Gibson Dunn LLP	Broadcom v Emulex	Emulex	Complete			2009	C.D. CA	09-cv-01058
Patent Infringement Wireless ICs	Keker & Van Nest LLP	Intel Corp. v. CSIRO Inc.	Intel	Complete	Y		2009	E.D. TX	06-cv-00551
Patent Infringement	Foley and Lardner LLP	SPH v Nokia	Nokia	Complete			2009	S.D. CA	3:2009-cv-02535
Patent Infringement	Fish and Richardson LLP	Tekelec v Performance Technologies Inc.	Performance Technologies; Inc.	Complete			2009	E.D. NC	09-cv-00531
Patent Infringement	McDermott Will & Emery LLP	Telecommunications Systems Inc. v Sybase 365 Inc.	Sybase	Complete			2009	E.D. VA	09-cv-00387
Patent Infringement	Kecker & Van Nest LLP	Kodak v HTC	HTC	Complete			2010	ITC	337-TA-831
Patent Infringement	Howrey LLP	WiAV v Motorola	Motorola	Complete	Y		2010	E.D. VA	3:09-cv-00447
Patent Infringement	Quinn Emanuel LLP	WiAV v Sony	Sony	Complete	Y		2010	E.D. VA	3:09-cv-00447
Patent Infringement	Covington LLP	Fujitsu v Belkin et al.	Fujitsu	Complete	Y	Y	2011	N.D. CA	10-cv-03972-LHK
Patent Infringement	Finnegan Henderson LLP Keker & Van Nest LLP	HTC v Apple Inc.	HTC	Complete	Y	Y	2011	ITC	337-TA-721

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Case Type	Firm	Case Name	Client	Status	Deposition	Trial Testimc	Enagement L	Venue	Case Number(s)
Patent Infringement	Hogan Lovells LLP	MOSAID v Cisco Inc.	MOSAID	Complete	Y		2011	ITC	337-TA-778
Patent Infringement	Quinn Emanuel LLP	Motorola v Apple Inc.	Motorola	Complete	Y		2011	S.D. FL; D. Del.	1:2010-cv-23580 1:2010-cv-00867
Patent Infringement	Finnegan Henderson LLP	HTC v Apple Inc.	HTC	Complete	Y		2012	ITC	337-TA-808
Patent Infringement	Proskauer LLP	MMI v Apple Inc.	MMI	Complete	Y		2012	D. Del.	1:10-cv-00258
Patent Infringement	Ropes and Grey LLP	Motorola v Microsoft Inc.	Motorola	Complete	Y	Y	2012	W.D. WA.	10-cv-01823
Patent Infringement	Quinn Emanuel LLP	Samsung v Apple Inc.	Samsung	Complete	Y	Y	2012	N.D. CA	11-cv-01846
Patent Infringement	Fish and Richardson LLP	VirneTX v Avaya	Avaya	Complete	Y		2013	E.D. TX	6:11-cv-00018
Patent Infringement and Trade Secret Cellular Phones	Heller Ehrman White & McAuliffe	Broadcom Inc. v Qualcomm Inc.	Qualcomm	Complete	Y		21-Jan-03	S.D. CA	05-cv-1392
Patent Infringement	Baker & McKenzie LLP and Kilpatrick Stockton LLP	Data Treasury Corp. v. Wells Fargo. et al.	Wells Fargo and Wachovia.	Complete	Y		6/27/05	E.D. TX	2:2005-cv-00291; 2:2005-cv-00293
Patent Infringement	Morrison & Foerster	Class v Apple	Apple	Complete			9/22/06	Unknown	Unknown
Patent Infringement	Cravath Swaine & Moore	Broadcom Inc. v Qualcomm Inc.	Qualcomm	Complete			10-Jan-07	C.D. CA	05-cv-00467
Patent Infringement	Cooley Godward Kronish LLP	Broadcom Inc. v Qualcomm Inc.	Qualcomm	Complete	Y	Y	13-Jan-08	ITC	337-TA-543
Arbitration	Cooley, Godward, Kronish LLP	Qualcomm v Panasonic	Qualcomm	Complete			6/24/09	Arbitration	None
Arbitration	Sidley Austin LLP	AT&T v. Intrado	AT&T Mobility LLC (f/k/a Cingular Wireless LLC) (_AT&TÓ);	Complete	Y		3-Nov-09	Arbitration	

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Case Type	Firm	Case Name	Client	Status	Deposition	Trial Testimc	Enagement L	Venue	Case Number(s)
Patent Infringement	Nixon Peabody; K&L Gates; Altson and Bird; Greenberg Traurig; Spotts Fain; Winston & Strawn; Goodwin Proctor	SPH America v Acer Inc. et al	Sierra Wireless; Novatel; Nokia; Hewlett Packard; UT Starcom; Motorola Solutions; Motorola Mobility.	Complete	Y		4/14/10	S.D. CA	3:2009-cv-02535
Patent Interference	Foley and Lardner LLP	Application Serial No 10/304,121 and U.S. Patent No. 7,084,529, Patent Interference No. 105,755(RES)	EnOcean GMBH	Complete			21-Jul-10	USPTO	Application Serial No 10/304,121 and U.S. Patent No. 7,084,529, Patent Interference No.
Patent Infringement	Mayer Brown LLP	MOSAID v Cisco	MOSAID	Complete	Y		9/10/10	D. Del.	10-cv-00687
Patent Infringement	Kilpatrick Townsend LLP	Golden Bridge v Motorola.	Motorola	Complete			5/20/11	D. Del.	1:2010-cv-00428
Patent Infringement	Quinn Emanuel LLP	Barnes & Noble v LSI	Barnes & Noble	Complete			6/14/11	N.D. CA	11-cv-02709
Patent Infringement	Covington LLP;Fish and Richardson LLP; Brinks Hofer Gilson & Lione LLP; Alston & Bird LLP	Interdigital v Huawei et al.	Huawei; LG; ZTE; Nokia	Complete	Y	Y	8/18/11	ITC	337-TA-800
Patent Infringement	Cravath LLP	Parkervision v Qualcomm	Qualcomm	Complete	Y	Y	11/2/11	MDFL	11-cv-00179
Patent Infringement	Latham & Watkins LLP	Sprint Communications v Time Warner Cable et al.	Time Warner Cable	Complete			1/30/12	D. KS	2:2011-cv-02686
Patent Infringement	Kilpatrick Townsend LLP	Digitude v Motorola	Motorola	Complete			14-Feb-12	ITC.	337-TA-827

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Case Type	Firm	Case Name	Client	Status	Deposition	Trial Testimc	Enagement L	Venue	Case Number(s)
Patent Infringement	Dechert LLP	Intellectual Ventures I LLC and Intellectual Ventures II LLC v. AT&T Mobility LLC; AT&T Mobility II LLC; New Cingular Wireless Services Inc.; SBC Internet Services Inc.; Wayport Inc.; T-Mobile USA Inc.; Nextel Operations Inc.; Sprint Spectrum L.P.; United States Cellular Corporation; and Telephone and Data Systems Inc.	Intellectual Ventures I LLC and Intellectual Ventures II LLC	Complete	Y		7/5/12	D. Del.	1:2012-cv-00193
Patent Infringement	McKenna Long & Aldridge LLP	Comerica v Maxim Integrated Products	Comerica	Complete			8/1/12	W.D. PA	12-mc-00244
Patent Infringement	DLA Piper LLP	Technology Properties Limited LLC ("TPL");Phoenix Digital Solutions LLC ("PDS") and Patriot Scientific Corporation ("PTSC") v Samsung Electronics Co. ltd. And Samsung Electronics America Inc.	Samsung	Complete			11/7/12	ITC	337-TA-853
Patent Infringement	Goodwin Procter LLP	WIAV Solutions v. ZTE Corporation. et at.	ZTE Corporation and ZTE (USA)	Complete			17-Dec-12	E.D. VA	1:12CV907
Patent Infringement	Fish and Richardson LLP	Ericsson v Samsung	Samsung	Complete			10-Jan-13	ITC	337-TA-862
Patent Infringement	Kirkland & Ellis LLP	SimpleAir Inc. v. Microsoft Corp. et al.	Samsung Electronics Co.; Ltd.; Samsung Electronics America; Inc.; and Samsung Telecommunications America LLC	Complete			19-Mar-13	E.D. TX	2:11-cv-00416-JRG
Patent Infringement	Winston & Strawn LLP	Adaptix v Motorola Mobility LLC et al.	Motorola Mobility	Complete			22-Mar-13	E.D. TX Tyler	6:12-cv-00016-MHS
Patent Infringement	Winston & Strawn LLP	Adaptix v Motorola Mobility LLC et al.	Motorola Mobility	Complete			22-Mar-13	N.D. CA	5:13-cv-01774-PSG
Patent Infringement	Bunsow De Mory Smith & Allison LLP	Cassidian Communications v. microData GIS Inc.; microData LLC; and TeleCommunications Systems Inc.	Cassidian Communications	Complete	Y	Y	1-Apr-13	E.D. TX Marshall	2:09-cv-00395-JRG
Patent Infringement	Kilpatrick Townsend & Stockton LLP	SimpleAir Inc. v. Microsoft Corporation et al.	Google Inc.	Complete	Y	Y	2-Apr-13	E.D. TX	2:11-cv-00416-JRG

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Case Type	Firm	Case Name	Client	Status	Deposition	Trial Testimc	Enagement L	Venue	Case Number(s)
Patent Infringement	Ropes & Gray LLP	InterDigital Technology Corp.IPR Licensing Inc. and InterDigital Holdings Inc	Samsung Electronics Co.; LTD.; Samsung Electronics America; Inc.; and Samsung Telecommunications America; LLC	Complete	Y		8-Apr-13	ITC Del.	337-TA-868 and Case No. 13-cv-OOO I I
Patent Infringement	Covington & Burling LLP	InterDigital Technology Corp.IPR Licensing Inc. and InterDigital Holdings Inc	Huawei	Complete	Y		12-Jun-13	ITC Del.	337-TA-868 and Case No. 13-009 (RGA)).
Patent Infringement	Covington & Burling LLP	InterDigital Technology Corp.IPR Licensing Inc. and InterDigital Holdings Inc	Huawei	Complete			12-Jun-13	Arbitration	
Patent Infringement	Brinks Hofer Gilson & Lione	InterDigital Technology Corp.IPR Licensing Inc. and InterDigital Holdings Inc	ZTE Corporation and ZTE (USA) Inc.	Complete			12-Jun-13	ITC Del.	337-TA-868 and Case No. 13-009 (RGA)).
Patent Infringement	Alston & Bird LLP	InterDigital Technology Corp.IPR Licensing Inc. and InterDigital Holdings Inc	Nokia Corporation and Nokia Inc	Complete			20-Jun-13	ITC Del.	337-TA-868 and Case No. 13-010 (RGA)).
Patent Infringement	Tensegrity Law Group LLP	Intellectual Ventures I LLC and Intellectual Ventures II LLC v Canon Inc. Canon U.S.A. Inc. and Canon Solutions America Inc.	Intellectual Ventures I LLC and Intellectual Ventures II LLC	Complete	Y		12-Jul-13	Del.	1:13-CV-00473-SLR (D. Del.)
Patent Infringement	Tensegrity Law Group LLP	Intellectual Ventures I LLC and Intellectual Ventures II LLC v Ricoh Company Ltd. Ricoh Americas Corporation and Ricoh Electronics Inc	Intellectual Ventures I LLC and Intellectual Ventures II LLC	Complete			12-Jul-13	Del.	1:13-CV-00474-SLR (D. Del.)
Patent Infringement	OMelveny & Myers LLP	Commonwealth Scientific and Industrial Research Organisation v. MediaTek Inc. et al.	Samsung Electronics Co.; Ltd.; Samsung Semiconductor Inc.; and Samsung Telecommunications America; LLC	Complete			19-Jul-13	E.D. TX	6:12-cv-578-LED

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Case Type	Firm	Case Name	Client	Status	Deposition	Trial Testimc	Enagement L	Venue	Case Number(s)
Patent Infringement	Feinberg Day Alberti & Thompson LLP	Intellectual Ventures v PNC Bank, Capital One, First National Bank of Omaha, JP Morgan Chase, Fifth Third Bank, Bank of America, BBVA Compass Bank, Commerce Bank, Suntrust, and M&T	Intellectual Ventures	Complete	Y		30-Aug-13	E.D. VA	1:13-cv-740-AJT/TRJ
Patent Infringement	Feinberg Day Alberti & Thompson LLP	Intellectual Ventures v PNC Bank, Capital One, First National Bank of Omaha, JP Morgan Chase, Fifth Third Bank, Bank of America, BBVA Compass Bank, Commerce Bank, Suntrust, and M&T	Intellectual Ventures	Complete			30-Aug-13	W.D. PA	2: 13-cv-00740-AJS
Patent Infringement	Gibson Dunn	AIP Acquisition LLC v. Cablevision Systems Corporation, et al.	CSC Holdings LLC	Complete			3-Sep-13	D. Del.	1:12-cv-01688-GMS)
Patent Infringement	Cooley LLP	Monec Holding AG v. Motorola Mobility LLC, et al.,	Exedea, Inc	Complete			27-Sep-13	CA	11-798-LPS-SRF
Patent Infringement	Cooley LLP	Monec Holding AG v. Motorola Mobility LLC, et al.,	HTC Corporation	Complete	Y		27-Sep-13	CA	11-798-LPS-SRF
Patent Infringement	Kilpatrick Townsend & Stockton	Monec Holding AG v. Motorola Mobility LLC, et al.,	Motorola Mobility LLC	Complete	Y		27-Sep-13	CA	11-798-LPS-SRF
Patent Infringement	Fish & Richardson P.C.	Monec Holding AG v. Motorola Mobility LLC, et al.,	Samsung Electronics America, Inc. and Samsung Electronics, Inc.	Complete	Y		27-Sep-13	CA	11-798-LPS-SRF
Arbitration	Covington & Burling LLP	Sasken Communication Technologies Limited v. Spreadtrum Communications, Inc. and Spreadtrum Communications USA Inc	Spreadtrum	Complete	Y	Y	30-Sep-13	American Arbitration Association Internationa l Centre for Dispute Resolution	50-117-T-00924-12
Patent Infringement	FINNEGAN, HENDERSO N,LLP and HOLLAND & HART LLP	Cellport v. ZTE et al.	HTC Corp., et al	Complete			27-Oct-13	CO	1:13-cv-173 - RBJ
Patent Infringement	Dickstein Shapiro LLP, Lathrop & Gage, LLP	Cellport v. ZTE et al.	LG Electronics, Inc., et al	Complete			27-Oct-13	CO	1:13-cv-175 - RBJ

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Case Type	Firm	Case Name	Client	Status	Deposition	Trial Testimc	Enagement L	Venue	Case Number(s)
Patent Infringement	FOX ROTHSCHILD LLP, KING & SPALDING LLP	Cellport v. ZTE et al.	Nokia Corp., et al.	Complete			27-Oct-13	CO	1:13-cv-178 - RBJ
Patent Infringement	[illegible] McKENZIE LLP	Cellport v. ZTE et al.	Pantech Co. Ltd., et al	Complete			27-Oct-13	CO	1:13-cv-179 - RBJ
Patent Infringement	GREENBERG TRAURIG, LLP	Cellport v. ZTE et al.	Samsung Electronics Co., Ltd., et al	Complete			27-Oct-13	CO	1:13-cv-180 - RBJ
Patent Infringement	Sheppard Mullin Richter &	Cellport v. ZTE et al.	ZTE Corporation and ZTE	Complete			27-Oct-13	CO	1:12-cv-3296
Patent Infringement	Ropes & Gray LLP	Broadcom Corp. v. NXP Semiconductors USA, Inc.	Broadcom	Complete			11-Feb-14	CDCA	CV SA 8:13-829-MRP(MANx)
Patent Infringement	Quinn Emanuel LLP	GENBAND US LLC v. Metaswitch Networks Ltd., et. al.	Metaswitch Networks Ltd.	Complete	Y	Y	27-Feb-14	E.D. TX	2:14-CV-33-JRG-RSP
Patent Infringement	O'Melveny & Myers LLP	Concinnitas, LLC and George Hindman v. Samsung Telecommunications America, LLC, et al,	Electronics America, Inc. and Samsung	Complete			22-Apr-14	E.D. TX	2: 13-CV-824-JRG-RSP
IPR	Hill, Kertscher & Wharton,	Regarding the U.S. Patent No. 8,400,926 B2	HTC Corporation	Complete			9-May-14	USPTO	U.S. Patent No. 8,400,926 B2
IPR	Hill, Kertscher & Wharton, LLP	Regarding the U.S. Patent No. 8,134,600, 8,477,197, 8581,991	HTC Corporation	Complete			9-May-14	USPTO	U.S. Patent No. 8,134,600, 8,477,197, 8581,991
IPR	Morgan, Lewis & Bockius_LLP	Regarding the U.S.Patent No. 6,819,923	NEC Casio Mobile Communications Ltd. and NEC Corp of America	Complete			25-Jun-14	USPTO	U.S.Patent No. 6,819,923
IPR	Everett Upshaw, PLLC	Regarding the U.S.Patent No. 7,215,962	ZTE Corporation and ZTE (USA)	Complete	Y		25-Jun-14	USPTO	U.S.Patent No. 7,215,962
Patent Infringement	Fenwick & West LLP	Cellular Communications Equipment LLC v. Amazon.com, Inc. et al	Amazon Inc.	Complete			1-Jul-14	E.D. TX	TXED-6-13-cv-00569; consolidated with Case No. 6-13-cv-00507
Patent Infringement	Winthrop Shaw Pittman	Cellular Communications Equipment LLC v. HTC Corporation et al	HTC Corporation	Complete			1-Jul-14	E.D. TX	6:13-cv-00507

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Case Type	Firm	Case Name	Client	Status	Deposition	Trial Testimc	Enagement L	Venue	Case Number(s)
IPR	H.C. Park & Associates, PLC	Regarding the U.S.Patent No. 7,218,923	Pantech Co. Ltd., et al	Complete			2-Jul-14	USPTO	U.S.Patent No. 7,218,923
Patent Infringement	Pillsbury Winthrop Shaw Pittman	SPH America LLC v. ZTE Corp et. al.	ZTE Corporation and ZTE (USA) Inc.	Complete			10-Jul-14	ED TX	3:13-cv-02326
Patent Infringement	Pillsbury Winthrop Shaw Pittman	Novatel Wireless, Inc. v. ZTE Corp. et. al.	ZTE Corporation and ZTE (USA) Inc.	Complete			16-Jul-14	ED TX	3:12-cv-02576
Patent Analysis	Qualcomm	Analysis of Qualcomm portfolio	Qualcomm	Complete			6-Aug-14	Consulting	Analysis of Qualcomm portfolio
IPR	Pillsbury Winthrop Shaw Pittman	Regarding Vringo patents	ZTE Corporation and ZTE (USA) Inc.	Complete			21-Aug-14	USPTO	U.S. Patents
Patent Infringement	Finnegan, Henderson, Farabow,Garrett & Dunner, L.L.P.	OpenTV Inc. et. al. v. Apple, Inc.	OpenTV, Inc. and Nagravision, SA of the Kudelski Group	Complete			22-Sep-14	N.D. CA	14-cv-01622-JST
IPR	Foley and Lardner LLP	Regarding the U.S. Patent No. 8,532,231, 8,565,346	Huawei Technologies Co., Ltd., Futurewei Technologies, Inc. and Huawei Device USA,	Complete			14-Oct-14	USPTO	Regarding the U.S. Patent No. 8,532,231, 8,565,346
Patent Infringement	Desmarais LLP	Intellectual Ventures I LLC and Intellectual Ventures 11 LLC v. Nikon Corp., et al	Intellectual Ventures I LLC and Intellectual Ventures II LLC	Complete			11-Nov-14	Del.	1:11-CV-1025-SLR
Patent Infringement	Cooley LLP	ParkerVision, Inc. v Qualcomm Incorporated, et al	Qualcomm	Complete			15-Dec-14	MDFL	6:14-cv-00687
Patent Infringement	DLA Piper LLP	Technology Properties Ltd LLC et al. v. Samsung Electronics Co., Ltd	Samsung Electronics Co., Ltd.	Complete			22-Jan-15	N.D. CA	3:12-cv-03879
Patent Analysis	Cravath, Swaine & Moore LLP	Patent Investigation	Qualcomm	Complete			6-Mar-15		
Patent Infringement	Paul Hastings	Summit 6 LLC v. HTC Corp.	HTC Corp and HTC America	Complete			3-Apr-15	NDTX	7:14-cv-00014

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Case Type	Firm	Case Name	Client	Status	Deposition	Trial Testimc	Enagement L	Venue	Case Number(s)
Patent Infringement	Kolpatrick Townsend & Stockton LLP	Summit 6 LLC v. Motorola	Google/Motorola	Complete			8-Apr-15	NDTX	7:14-cv-00014
Patent Infringement	Quinn Emanuel LLP	Cellular Communications Equipment LLC v. Samsung Electronics Co.Ltd et al	Samsung Electronics Co., Ltd.,	Complete			8-Jun-15	E.D. TX	6:14-cv-759-JRG
IPR	Sterne, Kessler, Goldstein& Fox PLLC	Int'l Bus. Machines Corp. v IV	IV	Complete	Y		10-Jun-15	USPTO	2015-00089, 2015-00092
Patent Infringement	Novak, Druce Connolly Bove + Quigg LLP	Sonus Networks, Inc. v Inventergy, Inc. and Inventergy Global, Inc	Inventergy, Inc. and Invetergy Global, Inc	Complete			24-Jul-15	N.D. CA	15-cv-00322
Patent Infringement	Novak, Druce Connolly Bove + Quigg LLP	Sonus Networks, Inc. v Inventergy, Inc. and Inventergy Global, Inc	Inventergy, Inc. and Invetergy Global, Inc	Complete			24-Jul-15	MA	15-cv-10207
Patent Infringement	Novak, Druce Connolly Bove + Quigg LLP	Sonus Networks, Inc. v Inventergy, Inc. and Inventergy Global, Inc	Inventergy, Inc. and Invetergy Global, Inc	Complete			24-Jul-15	E.D. TX	14-cv612
Arbitration	Mayer Brown LLP	Nokia Technologies Ltd and LG Electronics, Inc.	LG Electronics, Inc.	Complete	Y		25-Sep-15	Arbitration	None
IPR	Sterne, Kessler, Goldstein& Fox PLLC	LM Ericsson v IV	Intellectual Ventures I LLC and Intellectual Ventures II LLC	Complete	Y		18-Dec-15	USPTO	2015-01872
IPR	Sterne, Kessler, Goldstein& Fox PLLC	Old Republic Group Inc. v IV	Intellectual Ventures I LLC and Intellectual Ventures II LLC	Complete	Y		18-Dec-15	USPTO	IPR2015-01992, CBM2015-00184
IPR	Sterne, Kessler, Goldstein& Fox PLLC	LM Ericsson v IV	Intellectual Ventures I LLC and Intellectual Ventures II LLC	Complete	Y		26-Dec-15	USPTO	2015-01873

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Case Type	Firm	Case Name	Client	Status	Deposition	Trial Testimc	Enagement L	Venue	Case Number(s)
Patent Infringement	Cooley LLP	ParkerVision, Inc. v Qualcomm Incorporated, et al	Qualcomm	Complete			1-Feb-16	ITC	337-TA-982
Patent Analysis	Norton Rose Fulbright US LLP	Patent Investigation	Qualcomm	Complete			22-Feb-16		
Patent Infringement	Fish & Richardson P.C.	TiVo Inc. v. Samsung Electronics Co., Ltd., et al.,	Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc.	Complete			14-Mar-16	EDTX	2:15-CV-1503
Patent Infringement	RuyakCherian LLC	Brocade Communications Systems, Inc.	Communications Systems, Inc.	Complete			4-May-16	None	None
IPR	Bragalone Conroy PC	Securus Technologies, Inc. v. Global Tel*Link Corporation	Securus Technologies, Inc	Complete	Y		6-May-16	USPTO	IPR2016-01123
Patent Infringement	Cooley LLP	Skky, LLC v. Facebook, Inc. et al.	Facebook, Inc.	Complete			7-Jun-16	?	16-cv-00094-WMW-FLN
IPR	Winthrop Shaw Pittman	Cellular Communications Equipment LLC v. AT&T et al	HTC Corporation, HTC America	Complete	Y		7-Jul-16	USPTO	Regarding U.S. Patents 8,457,676 and 8,570,957
IPR	Pillsbury Winthrop Shaw Pittman	Cellular Communications Equipment LLC v. AT&T et al	ZTE Corporation and ZTE (USA), Inc.	Complete			7-Jul-16	USPTO	Regarding U.S. Patents 8,457,676 and 8,570,957
Patent Infringement	Desmarais LLP	Uniloc USA, Inc. and Uniloc Luxembourg S.A. v. Cisco Systems, Inc.	Cisco Systems, Inc.	Complete			15-Jul-16	E.D. TX	6:15-CV-1175-JRG
Patent Infringement	Quinn Emanuel LLP	GENBAND US LLC v. Metaswitch Networks Ltd., et. al.	Metaswitch Networks Ltd.	Complete	Y		15-Jul-16	E.D. TX	2:16-cv-582-JRG-RSP
Patent Infringement	Duanne Morris	Ruckus Wireless, Inc. v Chrimar Systems d/b/a CMS Technologies and Chrimar Holding Company LLC	Ruckus Wireless	Complete			27-Jul-16		
Patent Infringement	Singularity IP & Foster Pepper PLLC	CommScope Technologies LLC v. Dali Wireless, Inc.,	CommScope Technologies LLC	Complete			17-Aug-16	N.D. Tx	3:16-cv-00477

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Case Type	Firm	Case Name	Client	Status	Deposition	Trial Testimc	Enagement L	Venue	Case Number(s)
Patent Infringement	Quinn Emanuel LLP	Huawei Technologies, Co. Ltd et al v. Samsung Electronics Co, Ltd. et al	Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc.	Complete	Y		23-Aug-16	NDCA	3:16-cv-02787
Patent Infringement	Foster Pepper PLLC	CommScope Technologies LLC v. Dali Wireless, Inc.,	CommScope Technologies LLC	Complete			15-Oct-16	N.D. Tx	3:16-cv-00477
Technology Review	Foster Pepper PLLC	Dali Wireless, Inc.	Dali Wireless, Inc.	Complete			28-Oct-16	None	None
Patent Analysis	Foster Pepper PLLC	Dali Wireless, Inc v. Fiplex Communications, Inc.	Dali Wireless, Inc	Complete			29-Oct-16		
Patent Infringement	Finnegan, Henderson, Farabow,Garrett & Dunner, L.L.P.	Certain Digital Cable and Satellite Products, Set-Top Boxes, Gateways, and Components Thereof	Sony Corporation	Complete			8-Dec-16	ITC	337-TA-1049
Patent Infringement	Irell & Manella, LLP	various patent disputes involving Mobile Telecommunications Technology, LLC ("MTel") and regarding United States Patents Nos. 5,590,403, 5,659,891, and 5,915,210.	Juniper Networks, Inc.	Complete			29-Dec-16		
Patent Infringement	Dechert, LLP, Winston & Strawn	Tech Pharmacy Services, LLC v. Alixa RX LLC., et al.	Alixa RX LLC	Complete	Y		6-Jan-17	EDTX	4:15-cv-766
Patent Infringement	Sheppard Mullin Richter & Hampton LLP	Papst Licensing GMBH & Co. KG v. ZTE Corporation and ZTE (USA), Inc.	ZTE (USA), Inc.	Complete	Y		27-Jan-17	EDTX	6: 15-cv-1100
Antitrust	Freitas Angell & Weinberg LLP	Intellectual VenturesI LLC v Capital One	Intellectual Ventures	Complete			15-Feb-17	MD	8:14-cv-111 (PWG)
IPR	Knobbe, Martens, Olson, & Bear LLP	Symantec Corporation ("Symantec") v, IV's U.S. Patent No. 7,757,298	IV	Complete			16-Feb-17	USPTO	2016-01433
Patent Infringement	Cooley LLP	Uniloc USA, Inc. et al. v. Facebook, Inc. et al.	Facebook, Inc.	Complete			17-Feb-17	EDTX	2:16-cv-00728

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Case Type	Firm	Case Name	Client	Status	Deposition	Trial Testimc	Enagement L	Venue	Case Number(s)
Patent Infringement	Feinberg Day Alberti & Thompson LLP	OpenTV Inc. v. NFL Enterprises, LLC	OpenTV, Inc.	Complete			23-Mar-17	EDTX	6:17-cv-00031
IPR	Finnegan, Henderson, Farabow,Garrett & Dunner, L.L.P.	Unified Patents (6,014,089, 7,346,313)	Unified Patents	Complete			4/8/17	USPTO	(6,014,089, 7,346,313
Patent Infringement	Irell & Manella, LLP	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. v. Sirius XM Radio, Inc.,	Fraunhofer	Complete			17-May-17		17-184-VAC-SRF
Technology Review	RuyakCherian LLC	XR Communications, LLC., dba Vivato Technologies v. Ruckus Wireless, Inc.	Ruckus Wireless	Complete			13-Jun-17	CDCA	2:17-cv-02961
Patent Infringement	DLA Piper LLP	Mobile Telecommunications Technologies, LLC v. Aruba Networks, Inc., et al.,	Aruba/HPE and HP	Complete			25-Aug-17	MD	16-md-2722
Patent Infringement	Dechert, LLP	Intellectual Ventures I LLC v. T-Mobile USA, Inc., T-Mobile US, Inc., Ericsson Inc., and Telefonaktiebolaget LM Ericsson	IV	Complete	Y	Y	29-Aug-17	EDTX	2:17-cv-00577-JRG
Patent Infringement	Cooley LLP	Silver State Intellectual Tech., Inc. v. Facebook, Inc. et al.	Facebook, Inc.	Complete			19-Sep-17	ND CA	4:17-cv-03349-JSW
Patent Infringement	Quinn Emanuel LLP	QCOM v Apple SD Cal	Qualcomm	Complete	Y		15-Nov-17	SD. Cal,	5:17-cv-0108-GPC-MDD,
Patent Infringement	Norton Rose	QCOM v Apple	Qualcomm	Complete	Y		15-Nov-17	ND Cal	5:17-md-02773-LHK,
Patent Infringement	Norton Rose	QCOM v Apple	Qualcomm	Complete	Y		15-Nov-17	ND Cal	5:17-cv-00220-LHK
Patent Infringement	Quinn Emanuel LLP	In the Matter of CERTAIN MOBILE ELECTRONIC DEVICES AND RADIO FREQUENCY	Qualcomm	Complete	Y		10-Jan-18	ITC	U.S. PATENT NO. 9,608,675
Patent Infringement	Paul Hastings	3G Licensing, S.A. et al v. HTC Corporation	HTC Corporation	Complete			7-Mar-18	Del.	1:17-cv-00083-LPS-CJB
Patent Infringement	Fish & Richardson P.C.	Sonus Networks, Inc. v. Metaswitch Networks Ltd. et al,	Metaswitch Networks Ltd.	Complete			19-Jun-18	EDTX Marshall	l 8-cv-00057-RWS, l 8-cv-00058-RWS, IPR
Request for Reexam	Dentons US LLP	Request for Reexam re: patent 7,814,216	Dentons	Complete			6-Sep-18	USPTO	US Patent 7,814,216
Contract Dispute	Jones Day	Qualcomm, Inc. v. Apple, Inc.	Qualcomm	Complete	Y		28-Sep-18	San Diego Supperior Ct	37-2017-00041389-CU-BC-NC
Patent Infringement	O'Melveny & Myers LLP	Top Victory Electronics (Taiwan) Co. Ltd. v. American Patents LLC	Top Victory Electronics	Complete			13-Dec-18	EDTX	4:18-cv-00768-ALM

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Case Type	Firm	Case Name	Client	Status	Deposition	Trial Testimc	Enagement L	Venue	Case Number(s)
Patent Infringement	Birch, Stewart, Kolasch & Birch, LLP	Blitzsafe Texas LLC v Mitsubishi Electric Corp, et al.	Mitsubishi	Complete			19-Feb-19	EDTX	2:17-cv-00430-JRG
IPR	Jones Day	Qualcomm/Intel PTAB Matters (U.S. Patent No. 9,608,675)	Qualcomm	Complete	Y		20-Feb-19	USPTO	IPR2018-01326 to 01330 and IPR2018-01340
Patent Infringement	Finnegan, Henderson, Farabow,Garrett & Dunner, L.L.P.	Uniloc Luxembourg S.A., Uniloc 2017 LLC ("Uniloc") v LG Electronics Inc., LG Electronics U.S.A., Inc., and LG Electronics MobileComm U.S.A., Inc. ("LG")	LG	Complete			11-Mar-19	NDCA	3:18 cv-06737-JST, 5:18-cv-06738-LHK, 3:18-cv-06739-JST, 3:18-cv-06740-JST) and PTO
Ex Parte	Finnegan, Henderson, Farabow,Garrett & Dunner, L.L.P.	TCL Communication Technology Holdings Ltd. ("TCL").	TCL	Complete			13-Mar-19	USPTO	U.S. Patent No. 7,149,510
Patent Infringement	Mayer Brown LLP	Maxell, Ltd., et al., v. Apple Inc.	Maxell	Complete	Y		15-Apr-19	EDTX	5:19-cv-00036-RWS
Patent Infringement	Maschoff Brennan	ICON Health & Fitness,I nc. v. Tme Fitness Technology, Inc	ICON	Complete			29-May-19	Missouri	4:18-cv-00439
Patent Infringement	Gibson Dunn	Sprint Communications Co. L.P. v. Cequel Communications, UC et al.	Altice USA	Complete	Y		17-Jun-19	Del.	I: 18-cv-01752-RGA
Patent Infringement	Charhon Callahan Robson & Garza, PLLC	United Access Technologies, LLC ("UAT") in connection with UAT's lawsuits against AT&T, Verizon, Frontier and CenturyTel,	UAT	Complete	Y		17-Jun-19		1:05-cv-00866-LPS, 1.11-cv-00338-LPS, 1:11-cv-00341-LPS
Patent Infringement	Susman Godfrey l.l.p.	Sol IP, LLC v. AT&T Mobility LLC, et al.	Sol IP	Complete	Y		24-Jul-19	E.D. Tex.	2:18-cv-00526; 2:18-cv-00527; 2:18-cv-00528
IPR	Kelley Drye & Warren LLP	Zomm / Apple PTAB Matters (U.S. Patent No. 9,608,675)	Zomm, LLC	Complete	Y		30-Jul-19	USPTO	IPR2019-275, IPR2019-277, IPR2019-1030
Patent Infringement	Fish & Richardson P.C.	Bell Northern Research, LLC v. LG Electronics Inc., et al.,	LG Electronics, Inc.	Complete			6-Aug-19	SD. Cal	18-cv-2864-CAB-BLM
Technology Consulting	Rose Fulbright US LLP	Sanyo v. Intel	Sanyo	Complete	Y		3-Dec-19	Chancery of Delaware	C.A. No. 2018-0723-MTZ
Patent Infringement	Sidley Austin LLP	LG Electronics Inc. v. Hisense Electronics Manufacturing Company of America	LG	Complete			15-Jan-20	CDCA	2:19-cv-09474-SJO-E

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Case Type	Firm	Case Name	Client	Status	Deposition	Trial Testimc	Enagement L	Venue	Case Number(s)
Patent Infringement	Ahmad, Zavitsanos, Anaipakos, Alavi, Mensing	Cellular Evolution, LLC v. AT&T Mobility, LLC and Cricket Wireless, LLC	Cellular Evolution	Complete			30-Jan-20	EDTX	19-cv-00228
Patent Infringement	Ahmad, Zavitsanos, Anaipakos, Alavi, Mensing	Cellular Evolution, LLC v. T-Mobile, US, Inc. and T-Mobile USA, Inc.,	Cellular Evolution	Complete			30-Jan-20	EDTX	19-cv-00232
Patent Infringement	Cooley LLP	ParkerVision v. Apple	Qualcomm	Complete			11-Feb-20	MDFL	3:15-cv-01477
Patent Infringement	Cooley LLP	ParkerVision v. Qualcomm	Qualcomm	Complete	Y		11-Feb-20	MDFL	6:14-cv-00687
IPR	Wolf Greenfield LLP	MediaTek v NTT	MediaTek	Complete	Y		2-Jul-20	USPTO	Re U.S. Patent Nos. 7,280,551 and 7,400,616
Patent Infringement	Mintz, Levin	Parus Holdings, Inc.	Parus Holdings	Complete			31-Aug-20	WDTX	Not specified
Patent Infringement	Venable LLP	Blitzsafe Texas LLC v. Fiat Chrysler Automobiles N.V., FCA US LLC et al.	Maserati North America Inc. and FCA US LLC	Complete	Y		8-Sep-20	EDTX	2:19-cv-00378-JRG
IPR	Wolf Greenfield LLP	Bose Corporation v. KOSS Corporation	Bose	Complete	Y		20-Oct-20	USPTO	U.S. Patent No. 10,368,155
Patent Infringement	Shearman & Sterling LLP	StratosAudio, Inc. v. Volkswagen Group of America, Inc	Volkswagen	Complete	Y		13-Jan-21	WDTX	6:20-cv-1131
Patent Infringement	Fish & Richardson P.C.	Ericsson Inc v. Samsung Electronics Co.	Samsung	Complete			11-Mar-21	ITC and EDTX	337-TA-1248 and No. 2:20-cv-380 (E.D. Tex),
Patent Infringement	Dechert, LLP	IPCom v AT&T Inc, Verizon, Sprint	IPCom	Settled	Y		17-Mar-21	EDTX	IPCom Gmbh & Co. KG v. AT&T Inc. et al., Case No. 2:20-cv-00322 (E.D. Tex.); IPCom Gmbh & Co. KG v. Verizon Communications Inc. et al., Case No. 2:20-cv-00323 (E.D. Tex.); and IPCom Gmbh & Co. KG v. Sprint Spectrum L.P. et al., Case No. 2:20-cv-00321 (E.D. Tex.)

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Case Type	Firm	Case Name	Client	Status	Deposition	Trial Testimc	Enagement L	Venue	Case Number(s)
Patent Infringement	Sidley Austin LLP	WSOU v. Hewlett Packard	Hewlett Packard	Settled			4-Jun-21	WDTX	U.S. Patent Nos. 7,280,534; 7,386,630; 7,443,832; 7,519,056; 7,646,729; 8,462,774; and 9,398,629
Patent Infringement	Desmarais LLP	Cellspin Soft, Inc. v. Google Fitbit, Inc.	Google / Fitbit	Complete			1-Jun-21	NDCA	4:17-cv-05928-YGR
Patent Infringement	Fish & Richardson P.C.	Cellspin Soft, Inc. v. Fossil, Inc.	Fossil	Complete			18-Aug-21	NDCA	4:17-cv-05933-YGR
Patent Infringement	DLA Piper LLP	Cellspin Soft, Inc. v. Nike Inc	Nike	Complete			28-Jul-21	NDCA	4:17-cv-05931-YGR
Patent Infringement	Harness Dickey	Cellspin Soft, Inc. v. Under Armour, Inc.	Under Armor	Complete			4-Aug-21	NDCA	4:17-cv-05932-YGR
Patent Infringement	Lamkin IP	Cellspin Soft, Inc. v. Garmin, Inc.	Garmin	Complete			6-Aug-21	NDCA	4:17-cv-05934-YGR
Patent Infringement	Morrison & Foerster	Cellspin Soft, Inc. v. Nikon, Inc.	Nikon	Complete			23-Aug-21	NDCA	4:17-cv-05936-YGR
Patent Infringement	Fish & Richardson P.C.	Smart Mobile Technologies, LLC v. Samsung Electronics	Samsung	ongoing			1-Oct-21	CDTX	6:21-cv-00701-ADA
Patent Infringement	Ruyak Cherian LLP	Bright Data Ltd. v. NetNut Ltd.	Bright Data	Complete	Y		7-Oct-21	EDTX	2:21-cv-00225-JRGRSP
Patent Infringement	Quinn Emanuel LLP	Verkada, Inc. v. Motorola Solutions Inc.	Verkada	Complete	Y	Y	25-Oct-21	ITC	Inv. No. 337-TA-1281
Patent Infringement	Mayer Brown LLP	Maxell, Ltd., v. Lenovo Group Ltd., Lenovo (United States) Inc., and Motorola Mobility LLC	Maxell	Complete			9-Nov-21	WDTX	6:21-cv-01169
Patent Infringement	Mayer Brown LLP	Maxell, Ltd., v. Lenovo Group Ltd., Lenovo (United States) Inc., and Motorola Mobility LLC	Maxell	Complete			9-Nov-21	ITC	Inv. No. 337-TA-1324
Patent Review		Collision Communications	Collision	Complete			1-Feb-22		
Patent Infringement	Kasowitz Benson Torres LLP	IV v GM	IV	Complete			18-Feb-22	WDTX	6:21-cv-01088-ADA
Patent Infringement	Kasowitz Benson Torres LLP	IV v Toyota	IV	Complete			18-Feb-22	WDTX	2:21-CV-00389-JRG-RSP
Patent Infringement	Kasowitz Benson Torres LLP	IV v Honda	IV	Complete			18-Feb-22	WDTX	2:21-CV-03090-JRG-RSP
Patent Infringement	LTL Attorneys LLP	Howlink GIobal LLC v. Verizon Comm'ns, et al.	Howlink	Complete			21-Mar-22	EDTX	22-cv-00040

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Case Type	Firm	Case Name	Client	Status	Deposition	Trial Testimc	Enagement L	Venue	Case Number(s)
Patent Infringement	LTL Attorneys LLP	Howlink Global LLC v. AT&T, Inc.,et al.	Howlink	Complete			21-Mar-22	EDTX	22-cv-00042
Patent Infringement	Heim Payne Chorush LLP	Telecom Network Solutions v. AT&T	Telecom Network Solutions	Complete			20-Apr-22	EDTX	2:21-cv-00415-JRG,
Patent Infringement	Heim Payne Chorush LLP	Telecom Network Solutions v. Verizon,	Telecom Network Solutions	Complete			20-Apr-22	EDTX	2:21-cv-00416-JRG,
Patent Infringement	Heim Payne Chorush LLP	Telecom Network Solutions v. T-Mobile	Telecom Network Solutions	Complete			20-Apr-22	EDTX	2:21-cv-00418-JRG,
Patent Infringement	Baker Botts LLP	LG Electronics Inc. v. TCL Electronics Holdings Ltd. et al.,	LG Electronics, Inc.	Complete			17-May-22	EDTX	2:22-cv-00122
Patent Infringement	Ruyak Cherian LLP	Bright Data Ltd. Various IPRs	Bright Data	Ongoing	Y		1-Jun-22	USPTO	IPR 2022-00861, IPR 2022-00862
Patent Infringement	K&L Gates LLP	Competitive Access Systems, Inc. v. Oracle Corporation	CAS	Complete			23-Sep-22	EDTX	2:22-cv-00287
Patent Infringement	Jones Day	BJ's Wholesale Club Holdings, Inc. v. Walmart Apollo, LLC	Walmart	Complete			11-Nov-22	USPTO	IPR2022-01471, IPR2022-01528, IPR2022-01561, IPR2022-01563, IPR2022-01564
Patent Infringement	Ruyak Cherian LLP	Metacluster LT, UAB v. Bright Data Ltd.	Bright Data	Ongoing	Y		1-Feb-23	EDTX	2:22-cv-11-JRG-RSP
Patent Infringement	Sterne, Kessler, Goldstein& Fox PLLC	Roku, Inc. v Dolby International AB	Roku	Complete			8-Feb-23	USPTO	IPR - '757 Patent
Patent Infringement	Baker Botts, LLP	AGIS Software Development, LLC v Samsung Electronics Co, Ltd.	Samsung	Ongoing			16-May-23	EDTX	2:22-cv-00263-JRG-ADA
Patent Infringement	BartlitBeck LLP	General Access Solutions Ltd. V. Verizon, et. al.	GAS	Complete			7-Feb-23	USPTO	IPR
Patent Infringement	Susman Godfrey l.l.p.	Koninklijke KPN N.V. v Ericsson	KPN	Complete			7-Mar-23	EDTX	2:22-cv-282
Patent Infringement	Mintz, Levin	Mullen Industries v Apple Inc.	Mullen	Complete			3-May-23	USPTO	IPR
Patent Infringement	Fish & Richardson P.C.	Entropic Communications, LLC v DISH Network Corp.	DISH	Ongoing			30-Jun-23	USPTO	IPR
Patent Infringement	Jones Day	The Talisman Group, LLC. v Light and Wonder (LNW Gaming, Inc)	LNW	Ongoing			14-Apr-23	USPTO	IPR

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Case Type	Firm	Case Name	Client	Status	Deposition	Trial Testimc	Enagement L	Venue	Case Number(s)
Patent Infringement	Russ August &Kabat	Headwater Research LLC	Headwater	Ongoing			8-Sep-23		
Patent Infringement	Russ August &Kabat	Cobblestone Wireless, LLC v. T-Mobile USA, Inc.,	Cobblestone	Ongoing			1-Dec-23	EDTX	2:22-cv-477
Patent Infringement	Russ August &Kabat	Cobblestone Wireless, LLC v. Cellco Partnership d/b/a Verizon Wireless,	Cobblestone	Ongoing			1-Dec-23	EDTX	2:23-cv-382
Patent Infringement	Anand & Anand	LG Electronics Inc. versus Vivo Mobile India Private Limited & Ors.	LG	Ongoing			12-Dec-23	Delhi High C	CS. (Comm) 665 of 2023