

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

DELL INC., and DELL TECHNOLOGIES INC.

Petitioners

v.

AX WIRELESS LLC,

Patent Owner.

IPR2024-00708

U.S. Patent No. 11,212,146

**DECLARATION OF THOMAS LA PORTA, PH.D.
IN SUPPORT OF INTER PARTES REVIEW OF U.S. 11,212,146**

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I. Introduction

I, Thomas LaPorta, Ph.D., declare as follows:

1. I have been retained by Perkins Coie LLP on behalf of Dell Inc. and Dell Technologies Inc. (collectively “Dell” or “Petitioner”), to provide this Declaration concerning technical subject matter relevant to the petition for *Inter Partes* Review (“Petition”) of U.S. Patent No. 11,212,146 to Kim, et al (“the ’146 patent”). It is my understanding that the ’146 patent is currently assigned to AX Wireless LLC (“Patent Owner”).

2. I am over 18 years of age. I have personal knowledge of the facts stated in this Declaration and could testify competently to them if asked to do so. I have reviewed and am familiar with the specification and the claims of the ’146 patent. In general, I will cite to the specification of a United States Patent using the following formats: (Patent No., Col:Line Number(s)) or (Patent No., Paragraph Number(s)). For example, the citation (’146 patent, 1:1-10) points to the ’146 patent specification at column 1, lines 1-10. Also, for convenience, I use italics to denote limitations from the challenged claims.

3. All of the opinions contained in this Declaration are based on the documents I have reviewed and my knowledge and professional judgment. In forming the opinions expressed in this Declaration, I reviewed the documents listed in the attached Appendix. I have also reviewed and am familiar with any

other document referred to in this Declaration.

4. I have been asked to provide my technical opinions regarding how a person of ordinary skill in the art (“POSITA”) would have understood the claims of the ’146 patent at the time of the alleged invention. For purposes of whether the teachings of the prior art render the claims of the ’146 patent obvious, I have been asked to assume the date of August 21, 2009, for the analysis in this document.

5. I have also been asked to provide my technical opinions on how concepts in the ’146 patent specification relate to claim limitations of the ’146 patent. In reaching the opinions provided herein, I have considered the ’146 patent, its prosecution history, and the references cited in Attachment A, and have drawn as appropriate on my own education, training, research, knowledge, and personal and professional experience.

A. Qualifications and Expertise

6. In formulating my opinions, I have relied on my knowledge, training, and experience in the relevant field, which I will summarize briefly. A more detailed summary of my background, education, experience, and publications is set forth in my curriculum vitae (“CV”), which is provided as DELL-1004.

7. I have personal knowledge of the facts and opinions set forth in this declaration and believe them to be true. If called upon to do so, I would testify competently thereto. I have been warned that willful false statements and the like

are punishable by fine or imprisonment, or both.

8. I am being compensated for my time at my standard consulting rate. I am also being reimbursed for expenses that I incur during the course of this work. My compensation is not contingent upon the results of my study and analysis, the substance of my opinions, or the outcome of any proceeding involving the Challenged Claims. I have no financial interest in the outcome of this matter or in any litigation involving the '146 patent.

9. I am the Director of the School of Electrical Engineering and Computer Science at Penn State University. I am also an Evan Pugh Professor in the Department of Computer Science and Engineering and the Department of Electrical Engineering at Penn State University. I was the founding Director of the Institute of Networking and Security Research at Penn State. I have worked on telecommunications networks since 1986.

10. I received my B.E. and M.E. in Electrical Engineering from The Cooper Union for the Advancement of Science and Art in 1986 and 1987, respectively, and my Ph.D. in Electrical Engineering from Columbia University in 1992.

11. I joined AT&T Bell Labs (which later became Bell Labs, Lucent Technologies) in 1986 after receiving my B.E. degree, and pursued my M.E. degree part-time. In my first job at Bell Labs, I tested the performance and

interoperability of many data communication devices within the AT&T network. I transferred into Bell Labs Research in 1990 to pursue research full-time.

12. Starting in 1994, I performed research directed towards mobile and wireless networks. During this period, I worked extensively on signaling protocols and call processing for mobile telephony networks and mobile data applications. A large portion of my work was directed at architectures, protocols, and software for enabling different types of services on wireless networks. As part of this work I worked on efficient wireless link layer protocols.

13. In 1997, I became the Director of the Mobile Networking Research Department within Bell Labs Research. This group, which included approximately 30 researchers and support developers, carried out basic research on mobile networks including cellular telephony, mobile Internet, integrated networks and mobile data services. In 2000, I was named the Director of the Advanced Mobile Networking Department within the Wireless Business Unit of Lucent Technologies. My role in this job was to work with development organizations to turn technology into products.

14. During both my development and research careers, I interacted extensively with computer scientists and engineers responsible for the design, development, and testing of mobile telephony and data networking products with a focus on wireless networks. As a research manager, I oversaw a department that

executed many large-scale joint projects with development organizations to release products for Lucent Technologies. Examples of such joint projects include, the control software for Lucent Technologies' 3G network access controllers used for interconnecting CDMA base stations, processor overload controls in Lucent Technologies' cellular soft switches, the industry's first multi-protocol Home Location Register, servers and protocols for enabling services and interactive text messaging via cellular networks, the first systems to interwork 2G and 3G networks of different types with all-IP networks, and mobile Internet services. These interactions exposed me to a wide range of computer scientists and engineers working on wireless network technologies and applications.

15. As the Director of both the Networking Research Department in Bell Labs and the Advanced Mobile Networking Department within the Wireless Business Unit of Lucent Technologies, I met extensively with product managers and marketing organizations for the Wireless Business Unit of Lucent Technologies and representatives of many cellular service providers. In these meetings, I would often present new concepts and product directions that the company was advancing in the wireless market.

16. I also taught as an adjunct member of the faculty at Columbia University in 1993 and from 1996-2001. I taught graduate classes in networking protocol design (1993) and mobile computing and networking (1996-2001). As

such, I am familiar with the curricula taught to Electrical Engineers and Computer Scientists from the early 1990s until today.

17. I am a co-inventor on at least 39 United States Patents and 18 foreign patents, of which the large majority pertain to mobile telecommunications. Two of my patents, one of which helped enable the mobile Internet, were awarded the Thomas Alva Edison Patent Award by the Research and Development Council of New Jersey. For my early work I was recognized with an Eta Kappa Nu Outstanding Young Electrical Engineer Award and the Bell Labs Distinguished Staff Award.

18. While at Bell Labs, I led my research department into creating new network, service and software architectures for building some of the first wireless mobile data services. One example was designing a link layer protocol for more efficient wireless transmissions. This led to two patents and two published papers. I performed several other research efforts to improve the efficiency of the use of wireless networks in different types of data systems.

19. After joining Penn State I continued my work on wireless networks and services including several that were related wireless communications. This included work on allocating resources to efficiently use wireless bandwidth in OFDM systems and resulted in several published papers.

20. Because of my expertise on security in wireless networks, I was

appointed to The President's National Security Telecommunications Advisory Committee. My role on this Committee was to identify security risks for current and evolving cellular networks.

21. Based on this experience, and my continuing work at Penn State University, I have intimate knowledge of wireless and mobile networks and services. I have been highly recognized as an expert in such systems. I was recognized with the Bell Labs Distinguished Member of Technical Staff award in 1996. My award letter stated in part, “[y]our contributions to wireless call processing have profoundly impacted Lucent. You are very well-known as demonstrated by your three best paper awards...”. I was named a Bell Labs Fellow in 2000, “[f]or outstanding contributions in mobile wireless networks in the area of call processing, signaling, mobility management, and applications.” I was named an IEEE Fellow in 2002 “for contributions to systems for advanced broadband, mobile data and mobile telecommunication networks.”

22. I previously served as the Editor-in-Chief of IEEE Personal Communications Magazine and was the founding Editor-in-Chief of IEEE Transactions on Mobile Computing. I have published about 300 technical papers in this field.

23. My research is supported primarily by the Department of Defense and the National Science Foundation. I was the Director of a center funded by the U.S.

Army Research Lab studying network science as it relates to communication networks. I also led a recently concluded project funded by the Defense Threat Reduction Agency to improve network reliability against attack by weapons of mass destruction. I am currently the Penn State Principal Investigator on an NSF/DoD funded project on 5G networks.

B. Understanding of Relevant Legal Principles

24. I am not a lawyer and will not provide any legal opinions. Although I am not a lawyer, I have been advised certain legal standards are to be applied by technical experts in forming opinions regarding the meaning and validity of patent claims.

25. I understand that a patent claim is invalid if it is anticipated or obvious in view of the prior art, and that a claim can be unpatentable even if all of the requirements of the claim cannot be found in a single prior-art reference. I further understand that invalidity of a claim requires that the claim be anticipated or obvious from the perspective of a person of ordinary skill in the art at the time the invention was made.

26. I have been informed that a patent claim is invalid if it would have been obvious to a person of ordinary skill in the art. In analyzing the obviousness of a claim, I understand the following factors may be taken into account: (1) the scope and content of the prior art; (2) the differences between the prior art and the

claims; (3) the level of ordinary skill in the art; and (4) any so called “secondary considerations” of non-obviousness, if they are present. I am not aware of any evidence of secondary considerations of non-obviousness relevant to the ’950 patent. I reserve the right to supplement this Declaration if Patent Owner (“PO”) introduces evidence of secondary considerations of non-obviousness.

27. I understand that to prove that prior art or a combination of prior art renders a patent obvious, it is necessary to:

- 1) identify the particular references that, singly or in combination, make the patent obvious;
- 2) specifically identify which elements of the patent claim appear in each of the asserted references; and
- 3) explain why a person of ordinary skill in the art would have combined the references, and how they would have done so, to create the invention(s) claimed in the patent.

28. I further understand that exemplary rationales that may support a conclusion of obviousness include:

- combining prior art elements according to known methods to yield predictable results;
- simple substitution of one known element for another to obtain predictable results;

- use of known technique(s) to improve similar devices (methods or products) in the same way;
- applying a known technique to a known device (method or product) ready for improvement to yield predictable results;
- “obvious to try” – choosing from a finite number of identified, predictable solutions with a reasonable expectation of success;
- known work in one field of endeavor may prompt variations of the work for use in either the same field or a different field based on design incentives or other market forces if the variations are predictable to a person of ordinary skill in the art; and
- some teaching, suggestion, or motivating in the prior art that would have led a person of ordinary skill in the art to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

29. I have also been informed that, in considering obviousness, hindsight reasoning derived from the patent at issue itself may not be used.

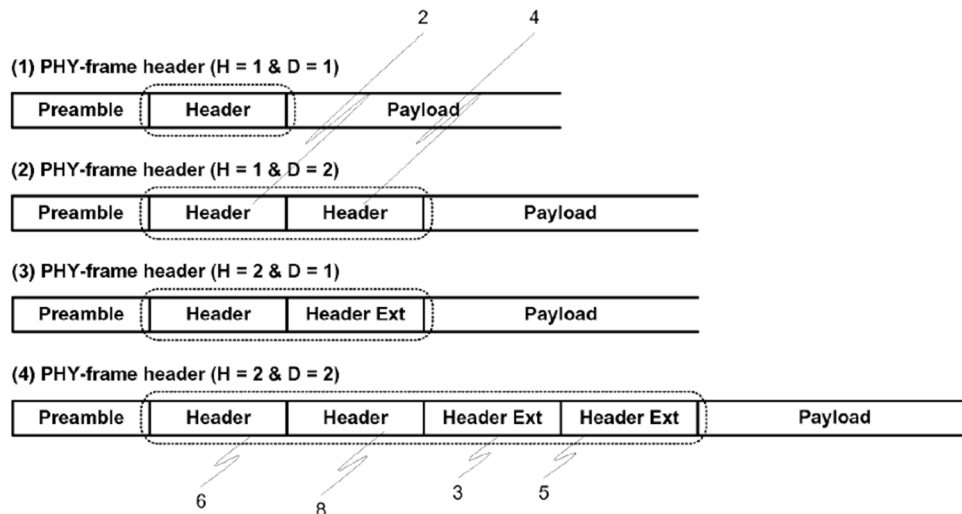
II. The '146 Patent

30. The '146 patent relates to “exemplary methods [and] systems . . . directed toward header repetition in a communications environment.”

(DELL-1001, 1:33–36.) According to the specification, “[t]he header contains

important control information for the receiver to decode the payload properly, and also provides information about the packet length for virtual carrier sensing,” so “it is essential to decode the header reliably.” (DELL-1001, 1:55–58.) In the prior art, it was known that a “header containing PHY_H bits (header information block) is carried over one or two OFDM symbols ($D=1$ or 2), and within each symbol, multiple header information blocks are repeated over the entire frequency band.” (DELL-1001, 1:60–64.) It was further known to extend a header to provide more information by “carrying more than PHY_H bits in the header ($H=1$ or 2).” (DELL-1001, 1:9–10.)

31. Both prior-art concepts are illustrated in Figure 1 from the '146 patent below. The value of “D” corresponds to the number of repetitions of the header field and “H” corresponds to the number of symbols required for a single header (*i.e.*, whether the header is extended).



In the first example ($H=1$ and $D=1$), the packet includes a “preamble followed by a header followed by a payload.” (DELL-1001, 5:57–59.) This represents a simple one-part header field. The second example ($H=1$ and $D=2$), the packet includes a preamble followed by a header that is repeated, followed by the payload. (DELL-1001, 5:59–61.) This “repeated header” example is a two-part header field with each part carrying the same information. (DELL-1001, 5:61–63.) In the third example ($H=2$ and $D=1$), the packet includes a preamble and header followed by a header extension and the payload. (DELL-1001, 5:63–65.) This “extended header” example is also a “two-part” header field, but the two parts carry different information. (See DELL-1001, 2:37–43.) And in the fourth example ($H=2$ and $D=2$), the packet includes a preamble, a header that is repeated, and a header extension that is also repeated, followed by the payload. (DELL-1001, 5:65–6:1.)

32. The '146 patent discusses “allowing different values of D in a single domain where nodes are operating in different portions of frequency bands” and “the level of frequency diversity is different depending on the bandplan.” (DELL-1001, 2:18–27.) For example, setting $D=2$ “increases reliability for the narrowband devices” because “each additional OFDM header symbol provides additional diversity thereby increasing the likelihood of decoding the header information correctly”; however, it “may also unnecessarily increase overhead for the wideband devices.” (DELL-1001, 2:28–31, 3:8–11.) The patent therefore

focuses on “receiver detection of D with variable repetition,” where “the transmitter selects (or determines)[] the at least one D value ... at its own discretion, or [] based on information communicated between the one or more receivers, or based on instructions from one or more other receivers and/or a domain master,” and the transmitter will “carry, insert or otherwise communicate the value of D in the header so that all nodes know how many OFDM symbols are carrying header information.” (DELL-1001, 2:51–3:1.) To ascertain the number of header symbols, “[t]he receiver(s) starts processing the header by decoding one OFDM header symbol,” and if successful, “the receiver knows how many more OFDM symbols (D-1) are carrying header information for a given frame.” (DELL-1001, 3:1–5.) But if unsuccessful “(i.e., the header decoding fails), then the receiver can try to decode two OFDM header symbols, and so on.” (DELL-1001, 3:5–8.) In other words, the patent specification teaches explicit signaling of the number of OFDM symbols carrying header information—which indicates the packet format—using a value “D” that the receiver decodes. The claims of the ’146 patent, however, more broadly recite a wireless receiver “configured to receive” first and second packet formats where the receiver “distinguishes the second packet format from the first packet format by detecting, from the received wireless packet, the second header field which repeats the first header field.” (*See, e.g.,* DELL-1001, cl.1.)

33. The Applicant, however, did not invent extending or repeating the header of an OFDM packet. In fact, PO admits in its provisional application that both were publicly disclosed and openly discussed prior to August 21, 2009, during development of the ITU-T G.hn standards for next-generation home network technology. (See DELL 1008, 21–22; DELL-1019; DELL-1020.) The challenged claims simply co-opt ideas disclosed in standards submissions from other companies and wrap them into a broadly recited wireless OFDM transceiver architecture.

A. Technical Background

34. In this section, I first provide a brief technical background of OFDM wireless communications and physical layer (PHY) packet headers in 802.11 standard-compliant wireless local area networks (WLANs), a high-level overview of the '146 patent and its prosecution history, and a discussion regarding claim construction.

35. The concepts of repeating and extending a header field in a wireless packet, and repeating an extended header field, were not novel prior to the earliest priority date of the '146 patent. In fact, the Applicant, Applied Transform, admitted these concepts were proposed in submissions by other companies during development of the “G.hn” standards mentioned in the '146 patent that were promulgated by the International Telecommunication Union – Telecommunication

Standardization Sector (ITU-T). (See DELL-1008, 21-22; DELL-1024; DELL-1025; DELL-1026.) I discuss the G.9960 standard and these contributions in §II.A.2. below.

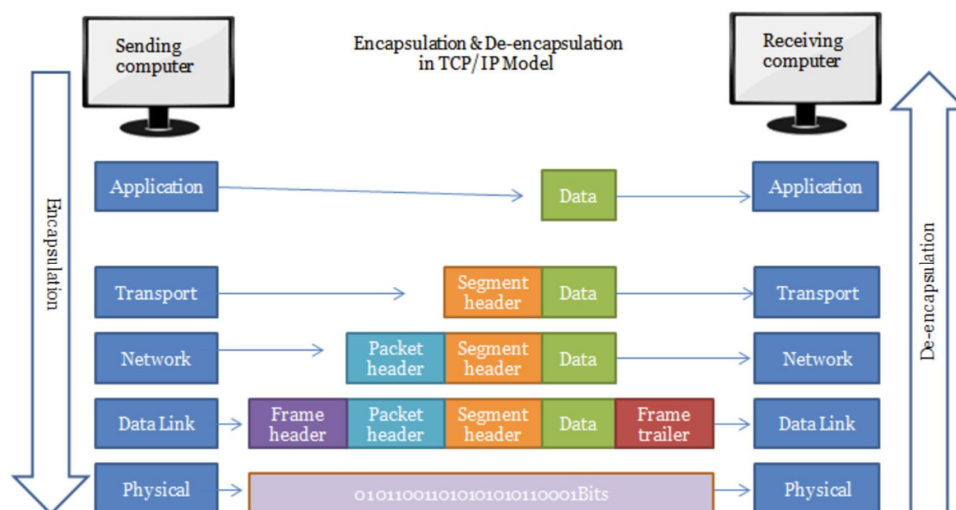
36. The ITU-T G.hn standards group was not the only standards group openly discussing the concepts of repeating and extending a physical layer header prior to the earliest possible priority date of August 2009. Four years before ITU-T G.hn considered these concepts, the IEEE 802.11 TGn working group discussed similar proposals from the TGn Sync and WWiSE industry groups during development of the IEEE 802.11n standard. I discuss these further in my analysis of Ground 1.

1. Communications Systems Overview

37. Computing devices communicate with one another over a network via network communication protocols. These communications generally involve transmitting information in the form of electrical signals (generally frequency waves) that propagate over a physical transmission medium that are subsequently received and processed in order to recover the information at the other end of the channel or link. These networks include wired and wireless networks and examples of transmission mediums include signal lines, coaxial cables and wireless air interfaces.

38. The network communication protocols that are used to communicate

over the transmission medium are generally defined in layers, with each layer being responsible for one aspect of the communications. The following figure illustrates this concept with reference to the common Open Systems Interconnection (OSI) model and the Transmission Control Protocol/Internet Protocol (TCP/IP) protocol suite. The application layer, at the top of the stack, handles interactions at the application level. The transport layer provides the flow of data between two computers for the application layer above it. TCP and UDP are two common transport layer protocols. The network layer handles the movement of packets around the network. IP is a common network layer protocol. The data link layer handles the details of physically interfacing with the physical media (e.g., coax, power line, air, etc.). And the physical layer performs the formatting operation that transforms the information received from the upper layers into a frame (or packet) that can be communicated as signals over the physical medium.



39. When an application sends data to an application running on a different computer, the data is sent down the protocol stack. Each layer adds information to the data by prepending headers (and sometimes trailer information) to the data that it receives, as shown in the figure above. Both the ITU G.hn and IEEE Std. 802.11, referenced by the '146 patent, are focused on the two lowest layers of the protocol stack—the data link layer and the physical layer.

a. Physical Medium

40. The difference between “wired” (e.g., coax) and wireless LANs is the physical communication medium. Unlike wired media, wireless media “are very difficult to control because the dynamics of the propagated signals over the media are constantly changing.” (DELL-1027, 161.) One key consideration in the design of a wireless LAN (WLAN) system is therefore path loss. As transmitting devices transmit signals to receiving devices in an area, “the signal attenuates as a square of the distance (D).” (DELL-1027, 166.) And “[a]s the receiver moves away from the transmitter, the receiver’s signal power decays until it reaches the receiver’s noise floor, at which time the bit error rate becomes unacceptable.” (DELL-1027, 166.) Additional path losses may occur because of the fading characteristics of the operating environment.

41. Fading is a major problem in WLAN system design. Most 802.11 equipment uses omnidirectional antennas, radiating RF energy in every direction.

The waves are reflected, for example, by the ground or buildings and scattered by objects such as trees, people, towers, or other moving and stationary objects present in the area. (See, e.g., DELL-1022, 771-772.) Reflections of a signal cause a delayed copy of the same transmission to be received on a different path. These environmental conditions contribute to fading. Large-scale fading is due to path loss of signal as a function of an object coming between the transmitter and receiver. (See DELL-1022, 947; D. Tse, et al., *Fundamentals of Wireless Communication*, 2 (2005) (“Tse”)) Small-scale fading is due to the constructive and destructive interference of the multiple signal paths between the transmitter and receiver. (DELL-1022, 947, 953-954; DELL-1016, 2.)

42. One solution to improve performance in a fading channel is to ensure that the information passes through multiple signal paths, each of which fades independently, making sure that reliable communication is possible provided one of the paths is strong. (DELL-1016, §3.1.4.) This technique creates what is called “diversity” for the transmission, and it can dramatically improve the performance of the system over fading channels. (DELL-1016, §3.1.4.) Three main forms of diversity are traditionally exploited in communication systems for fading channels: temporal (repeating transmission information in different time intervals), spectral (repeating transmission information in different frequencies), and spatial diversity (repeating transmission information over different transmit antennas).

43. A simple mechanism for achieving time diversity uses repetition coding. If a transmitted symbol is not repeated, a deep fade can wipe out a transmitted signal. And if the information lost due to the deep fade is part of the packet header, the entire packet cannot be decoded by the receiver. However, if the information is repeated, a deep fade wipes out only one copy of the repeated information, allowing the data to be potentially recovered in the other copy.

b. Idealized system model for orthogonal frequency division multiplexing (OFDM)

44. This section describes an idealized Orthogonal Frequency Division Multiplexing (OFDM) system model. OFDM is a digital multi-carrier modulation scheme that extends the concept of single subcarrier modulation by using multiple subcarriers within the same single channel. Rather than transmit a high-rate stream of data with a single subcarrier, OFDM makes use of a large number of closely spaced orthogonal subcarriers that are transmitted in parallel. Each subcarrier is modulated with a conventional digital modulation scheme (such as QPSK, 16QAM, etc.) at low symbol rate. This is also referred to as constellation mapping. However, the combination of many subcarriers enables data rates similar to conventional single-carrier modulation schemes within equivalent bandwidths.

45. OFDM is based on the well-known technique of Frequency Division Multiplexing (FDM). In FDM different streams of information are mapped onto separate parallel frequency channels. Each FDM channel is separated from the

others by a frequency guard band to reduce interference between adjacent channels. The OFDM scheme differs from traditional FDM in the following interrelated ways: (i) multiple carriers (called subcarriers) carry the information stream; (ii) the subcarriers are orthogonal to each other, and (iii) a guard interval is added to each symbol to minimize the channel delay spread and intersymbol interference.

46. In the frequency domain, multiple adjacent subcarriers (or tones) are each independently modulated with complex data. An Inverse Fast Fourier Transform (IFFT) function is performed on the frequency-domain subcarriers to produce the OFDM symbol in the time-domain. Then in the time domain, guard intervals are inserted between each of the symbols to prevent inter-symbol interference at the receiver caused by multi-path delay spread in the radio channel. Multiple symbols can be concatenated to create the final OFDM signal. At the receiver, a Fast Fourier Transform (FFT) is performed on the OFDM symbols in the received packet to recover the original data bits.

47. An OFDM carrier signal is the sum of a number of orthogonal subcarriers, with baseband data on each subcarrier being independently modulated using some type of quadrature amplitude modulation (QAM) or phase-shift keying (PSK) technique. This composite baseband signal is typically used to modulate a main radio frequency (RF) carrier for transmission over the channel, which is a

band of frequencies or a “frequency band”.

Transmitter IFFT Modulation

48. An IFFT function is computed on each set of symbols (time samples) to produce a set of complex time domain symbols (i.e., to “modulate” the symbols) which are the time-domain OFDM symbols. In OFDM, “modulation” takes place at the IFFT mapping the streams of data symbols onto OFDM symbols for transmission over the channel. The IFFT is therefore a “modulator” in an OFDM system. The OFDM symbols are transmitted over the channel to the receiver.

Receiver FFT Demodulation

49. At the receiver, a forward FFT function is used to convert the time-domain OFDM symbols back to the frequency domain (i.e., to “demodulate” the symbols). In OFDM, “demodulation” occurs at the FFT converting the received OFDM symbols to data symbols. The FFT is therefore a “demodulator” in an OFDM system. The output of the FFT is mapped onto binary values that are then decoded to produce the binary output data, which is an estimate of the originally transmitted data stream.

c. Simple digital OFDM system implementation using Fast Fourier Transform (FFT)

50. These IFFT/FFT transform functions are well known in the art and are important from the OFDM perspective because the IFFT maps digitally modulated input data (data symbols) onto orthogonal subcarriers (OFDM symbols) for

transmission, and vice versa for reception at the FFT. The IFFT is the “modulator” in an OFDM system because it takes frequency-domain input data (complex numbers representing the modulated subcarriers) and converts it into the time-domain output data (analog OFDM symbol waveform).

51. The IFFT takes in N source data symbols at a time. Each of these N input symbols has a symbol period of T seconds. The output of the IFFT is N orthogonal sinusoid waveforms. Thus, the IFFT block provides a simple way to “modulate” data onto N orthogonal subcarriers. The block of N output samples from the IFFT make up an OFDM symbol.

52. At the receiver, an FFT block is used to process the received signals and convert them (*i.e.*, demodulate them) into the frequency domain which is used to ultimately recover the originally transmitted data bits. Figure 2.14 of R. van Nee, et. al., *OFDM for Wireless Multimedia Communications*, 47-48 (2000) (“Van Nee”) below depicts a block diagram of a typical OFDM transceiver (or modem) where the upper path corresponds to the transmitter path and the lower path corresponds to the receiver path. As discussed above, the IFFT “modulates” the input values (*e.g.*, QAM, PSK, etc.) “onto a number of subcarriers” and “[i]n the receiver, the subcarriers are demodulated by an FFT, which performs the reverse operation of an IFFT.” (DELL-1021, 47-48.) “An FFT is used to demodulate all subcarriers” and the output of the FFT is “mapped onto binary values and decoded

to produce binary output data.” (DELL-1021, 48.) In this particular implementation, the same IFFT/FFT hardware is used for both transmitter and receiver.

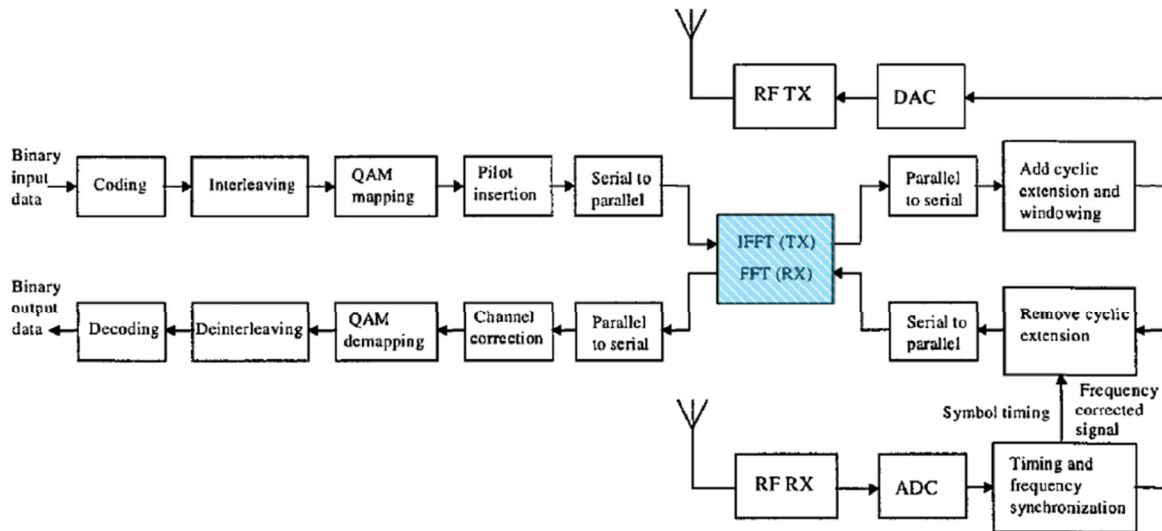


Figure 2.14 Block diagram of an OFDM transceiver.

2. ITU G.hn

53. ITU-T G.hn was tasked with developing standards for a next generation home networking technology that enabled transmission of video, audio and data over existing coax, phone line and power line wires in the home. The '146 patent is drafted using the same terminology as is found in the G.9960 standard specification.

a. G.9960

54. The goal of G.hn is to optimize a single transceiver for multiple types of media. The G.9960 specification defines the physical layers of G.hn. The '146

patent acknowledges the January 2009 version of G.9960 as prior art in its background section. (*See*, DELL-1001, 1:46-55 (“In G.9960, which is incorporated herein by reference in its entirety, and **should be familiar to those skilled in the art¹**”).)

55. The protocol reference model of a transceiver is illustrated in Figure 5-11 below. At the physical layer, the reference model includes (1) the physical coding sub-layer (PCS) which “encapsulates transmit packets into the PHY frame and adds PHY-related control and management overhead”, (2) the physical medium attachment (PMA) sub-layer, and (3) the physical medium dependent (PMD) sub-layer which “modulates and demodulates PHY frames for transmission over the medium using” OFDM. (DELL-1028, 24:711-715.)

¹ Unless otherwise noted, all emphasis by bold is added.

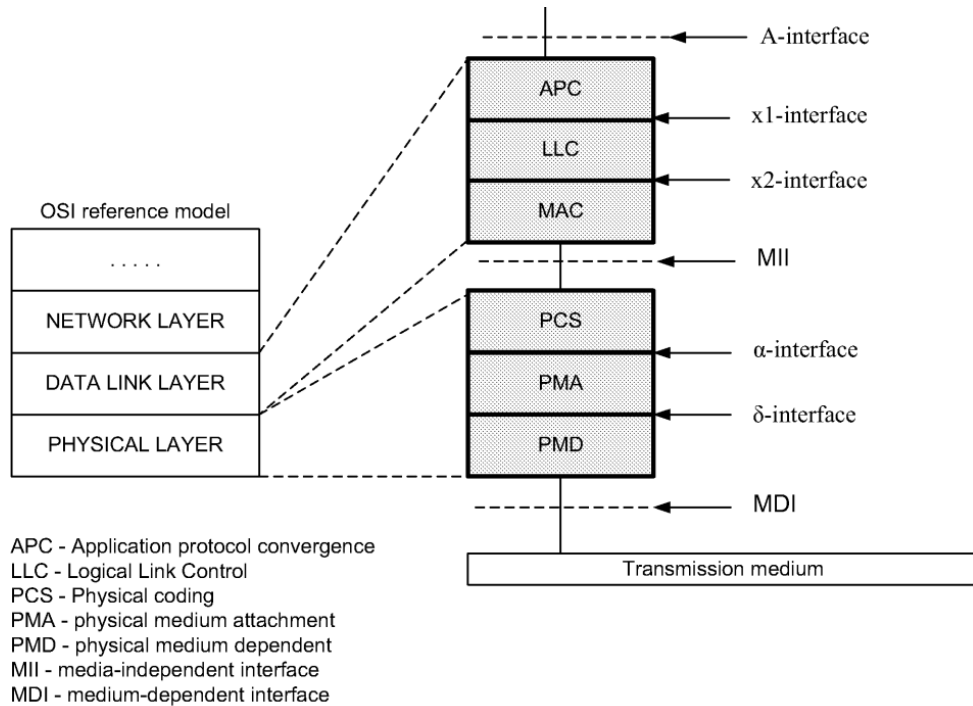


Figure 5-11/G.9960 – Protocol reference model of HN transceiver

56. In the transmit direction, data enters the PHY from the MAC as a block of data called a MAC protocol data unit (MPDU). (DELL-1028, 30:854-855.) The incoming MPDU “is mapped into the PHY frame originated in the PCS, scrambled and encoded in the PMA, modulated in the PMD, and transmitted over the medium using OFDM modulation with relevant parameters.” (DELL-1028, 30:855-858.) In the PMD, the “preamble is added to assist synchronization and channel estimation in the receiver.” (DELL-1028, 30:858-859.)

(i) Physical Coding Sub-Layer (PCS)

57. The functional model of the PCS is shown in Figure 7-2 of G.9960, reproduced below. In the transmit direction, “the incoming MPDU is mapped into a

payload field of a PHY frame” and the PHY-frame header “is added to form a TX PHY frame.” (DELL-1028, 31:869-871.) The TX PHY frame is passed over the α -interface to the PMD sublayer. (DELL-1028, 31:879.) In the receive direction, the decoded PHY-frame payload and header are processed and the MPDU provided to the MAC layer. (DELL-1028, 31:872-874.)

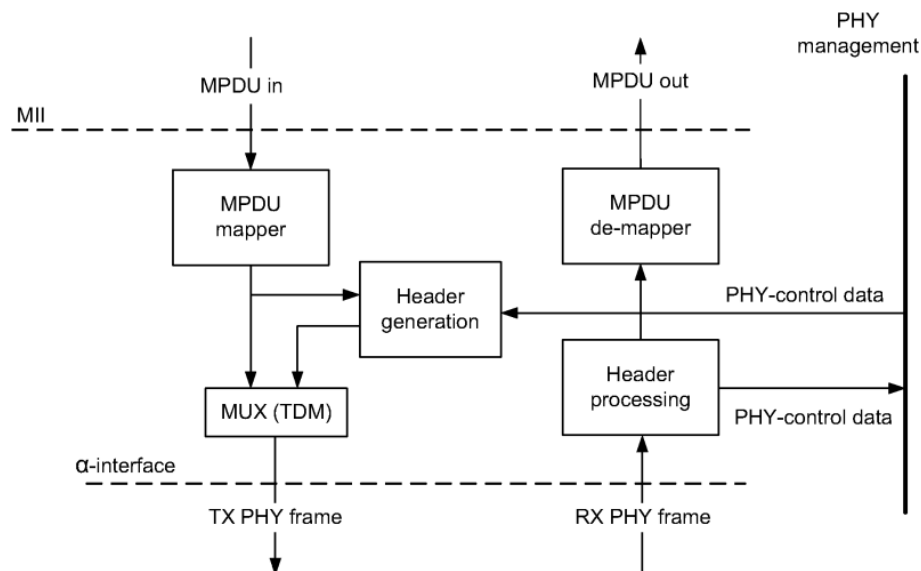


Figure 7-2/G.9960 – Functional model of PCS

58. The PHY frame (illustrated below) includes a preamble, header and payload. At the interface, the PHY frame includes only header and payload because the preamble is added in the PMD. (DELL-1028, 31:877-32:882.) The PHY-frame header is a two-part header. It is PHY_H bits long and is composed of (1) a common part (containing fields that are common for all PHY-frame types) and (2) a variable part that contains fields according to the PHY-frame type. (DELL-1028, 32:895-897.)

Preamble	Header	Channel estimation	Payload
Added in the PMD	1 or 2 symbol frames	Added in the PMD	Integer number of symbol frames; Variable length Variable inter-frame coding rate Variable inter-frame bit loading

Figure 7-3/G.9960 – Format of the PHY frame

(ii) Physical Medium Attachment (PMA) Sub-Layer

59. The functional model of the PMA is illustrated in Figure 7-4 of G.9960, reproduced below. As shown, in the transmit direction, the header bits and payload bits for the incoming PHY frame (except for preamble and channel estimation symbols) are scrambled are then encoded. After encoding, the header and payload are each segmented into an integer number of symbol frames and submitted to the PMD for modulation and transmission over the medium. (DELL-1028, 42:1101-1103.) In the receive direction, the inverse operations of decoding and de- scrambling are performed on received symbol frames.

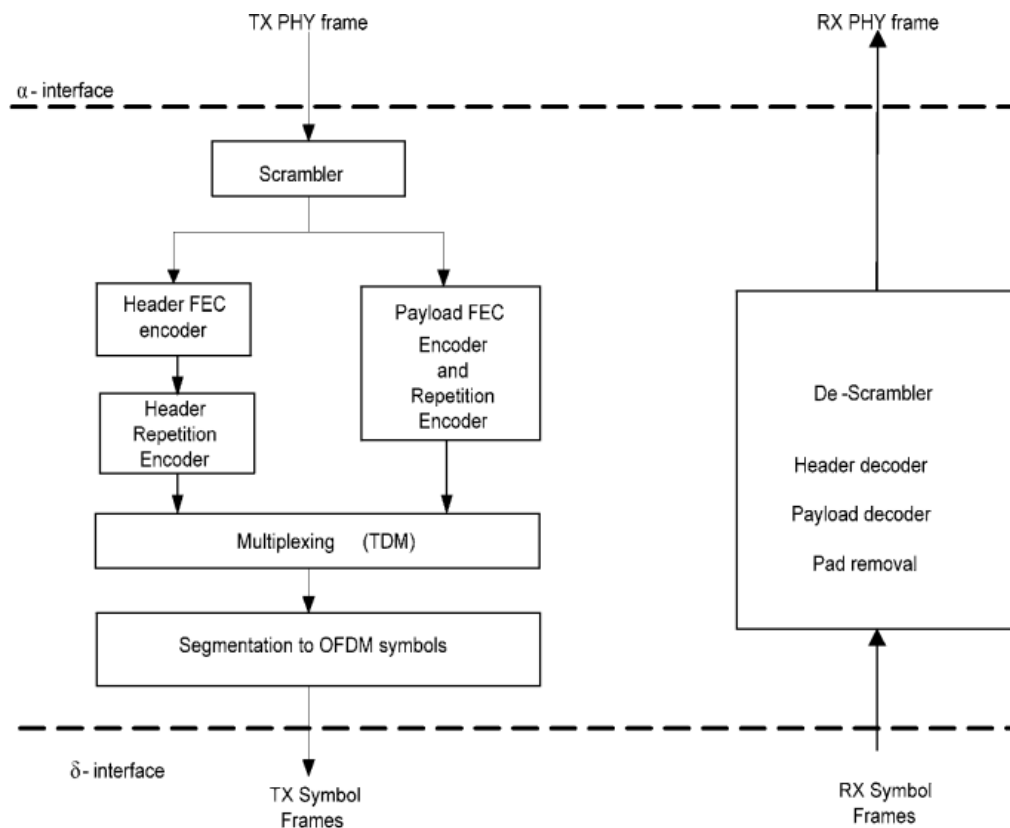


Figure 7-4/G.9960 – Functional model of PMA

(iii) Physical Medium Dependent (PMD) Sub-Layer

60. The functional model of the PMD is illustrated in Figure 7-11 from G.9960, reproduced below. In the transmit direction, the tone mapper divides the incoming symbol frames into groups of bits and associates each group of bits with a specific sub-carrier onto which this group shall be loaded. (DELL-1028, 52:1397- 1399.) The constellation encoder converts every group of incoming bits “into complex numbers which are, respectively, the real and imaginary part of the constellation point on which the particular group of bits is loaded for this subcarrier.” (DELL-1028, 52:1400-1402.) The OFDM modulator “converts the

stream of the N complex numbers at its input into a stream of N time domain samples.” (DELL-1028, 53:1407-1408.) After adding the preamble, the transmit signal is up- shifted to fit the required spectrum of the transmit signal. (DELL-1028, 53:1408-1410.)

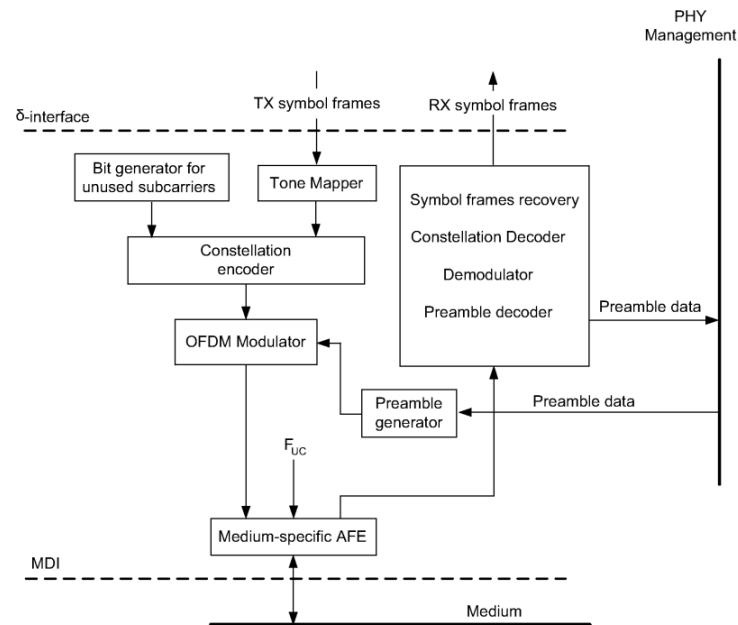


Figure 7-11/G.9960 – Functional model of the PMD

b. “G.hn: Extended PHY Frame Header” Contribution (July 2009)

61. The ’146 provisional admits that the G.hn group agreed in April 2009 that “G.hn shall specify means to extend the PHY-frame header.” (DELL-1008, 2.) The contribution, “G.hn: Extended PHY frame header”, from Intellon Corporation published in July 2009 proposed a technique for the header extension “add[ing] an option for supporting extended PHY frame headers that contain $2 \times \text{PHY}_H$ information bits.” (DELL-1026, 1.) The ’146 patent further admits that this contribution is prior art in its background section. (DELL-1001, 2:9-14.)

62. Intellon's contribution also notes that the current draft of G.9960 alludes to PHY frame headers that contain more than one symbol (although the reference does not specify whether these additional symbols are for PHY frame header symbol repetition or to support additional frame header information bits). (DELL-1026, 1.) The contribution proposes to define two one-bit fields in the PHY header: (1) an extended header indication (EHI) which indicates whether the header contains an extended number of bits and (2) an immediate response frame extended header indication (IREHI) which tells receivers if they should respond with a header containing PHY_H or $2 \times \text{PHY}_H$ bits. (DELL-1026, 2.)

c. "G.hn: Using Two Symbols for the Header of a PHY frame on Coax" Contribution

63. The contribution, "G.hn: Using Two Symbols for the Header of a PHY frame on Coax," by CopperGate Communications in July 2009 "proposes that the number of symbols used for the header of the PHY frame on coax" be fixed to exactly two because a single symbol does not provide adequate reliability. (DELL-1025, 1.) The '146 patent also admits that the CopperGate contribution was prior art. (DELL-1001, 1:46-62.) And the '146 provisional admits that this contribution was provisionally agreed to at the July 30, 2009 meeting. (DELL-1008, 2.)

64. The CopperGate contribution notes that the PHY-header "contain[s] important information necessary in order to process the payload." (DELL-1025, 1.)

The effective number of repetitions of the header “depends on the number of active subcarriers and on the number of header symbols.” (DELL-1025, 1.) CopperGate proposes to always use two header symbols on the coax medium. The contribution also describes a Header Encoder which includes a Header FEC encoder followed by a Header repetition encoder, which copies the FEC codeword. (DELL-1025, 2.)

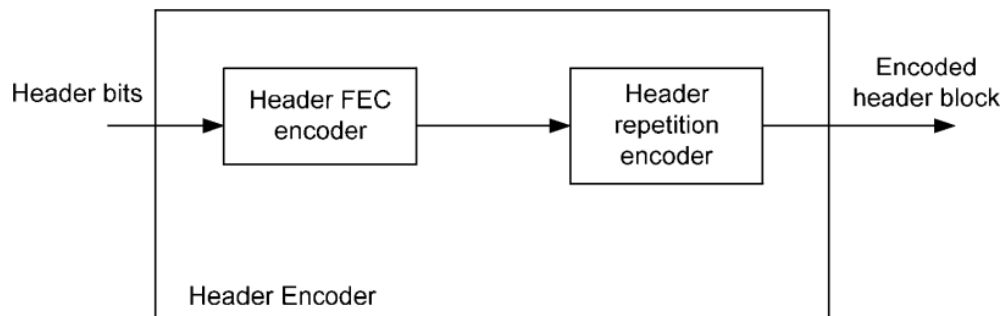
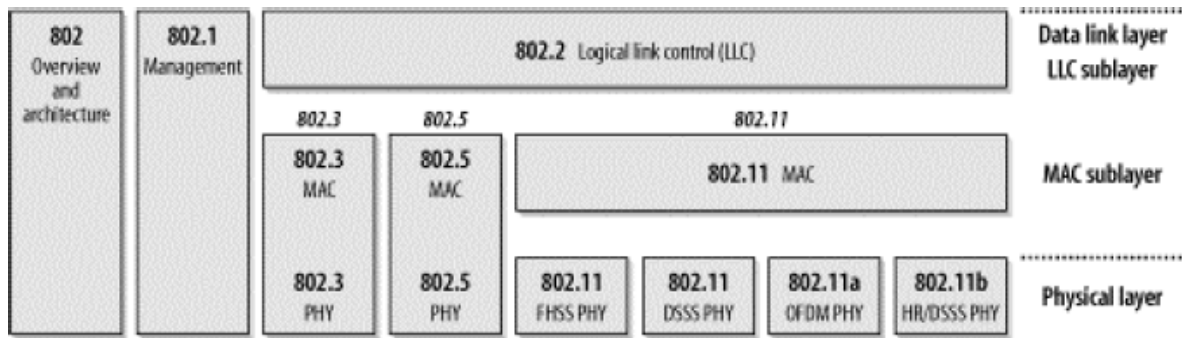


Figure 7-10/G.9960 – Functional diagram of the Header Encoder

3. IEEE 802

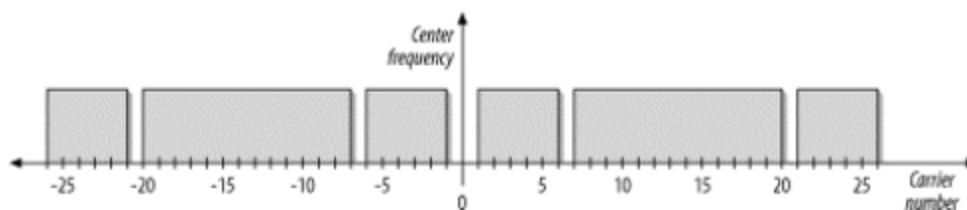
65. IEEE 802.11 is a member of the IEEE 802 family, illustrated below, which is a series of specifications for local area network (LAN) technologies. The base 802.11 specification includes two physical layer specifications: a frequency-hopping spread spectrum (FHSS) physical layer and a direct-sequence spread-spectrum (DSSS) layer. (DELL-1023, 8.) A later revision, 802.11a, added a physical layer based on orthogonal frequency division multiplexing (OFDM). (DELL-1023, 8.) Because the '146 patent relates to an OFDM physical layer, Petitioner describes 802.11a further below.



a. OFDM PHY (802.11a)

(i) Operating Channels

66. The OFDM PHY organizes the available spectrum “into operating channels.” (DELL-1023, 206.) For example, the operating channels in 802.11a “are specified as 20 MHz wide.” (DELL-1023, 206.) In the United States, channels in the 5- GHz band are numbered starting every 5 MHz and therefore each 20 MHz 802.11a channel “occupies four channels” shown in the following Table. (DELL-1023, 207). Each 20-MHz 802.11a channel is composed of 52 subcarriers. Four of the subcarriers are used as pilot carriers and 48 subcarriers are used to transmit data. The subcarriers are numbered from -26 to 26, as shown below. Subcarrier 0 is not used. Pilot carriers are assigned to subcarriers -21, -7, 7, and 21.



Gast, Figure 11-8

(ii) Physical Layer

67. The physical layer in 802.11 is divided into two sublayers: the Physical Layer Convergence Procedure (PLCP) sublayer and the Physical Medium Dependent (PMD) sublayer. (DELL-1023, 151.) The PLCP is “the glue between frames of the MAC and radio transmissions in the air.” (DELL-1023, 151.) The PMD is responsible for transmitting any bits it receives from the PLCP over the air using the antenna. (DELL-1023, 151.)

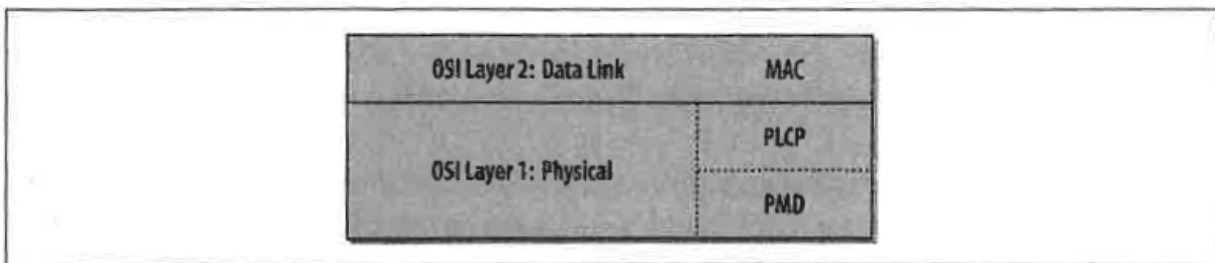


Figure 9-1. Physical layer logical architecture

68. The OFDM PHY layer creates a frame, referred to as the physical protocol data unit (PPDU), by adding a preamble and header to the data received for transmission from the MAC layer, as illustrated in Figure 122 from 802.11a standard. (DELL-1023, 208.) The 802.11a PPDU, illustrated below, includes a preamble that “synchronizes various timers between the transmitter and the receiver.” (DELL-1023, 209.) The PLCP header is transmitted in the Signal field. (DELL-1023, 209.) The header includes information regarding the data rate and number of bytes of the embedded MAC frame (length). (DELL-1023, 210.)

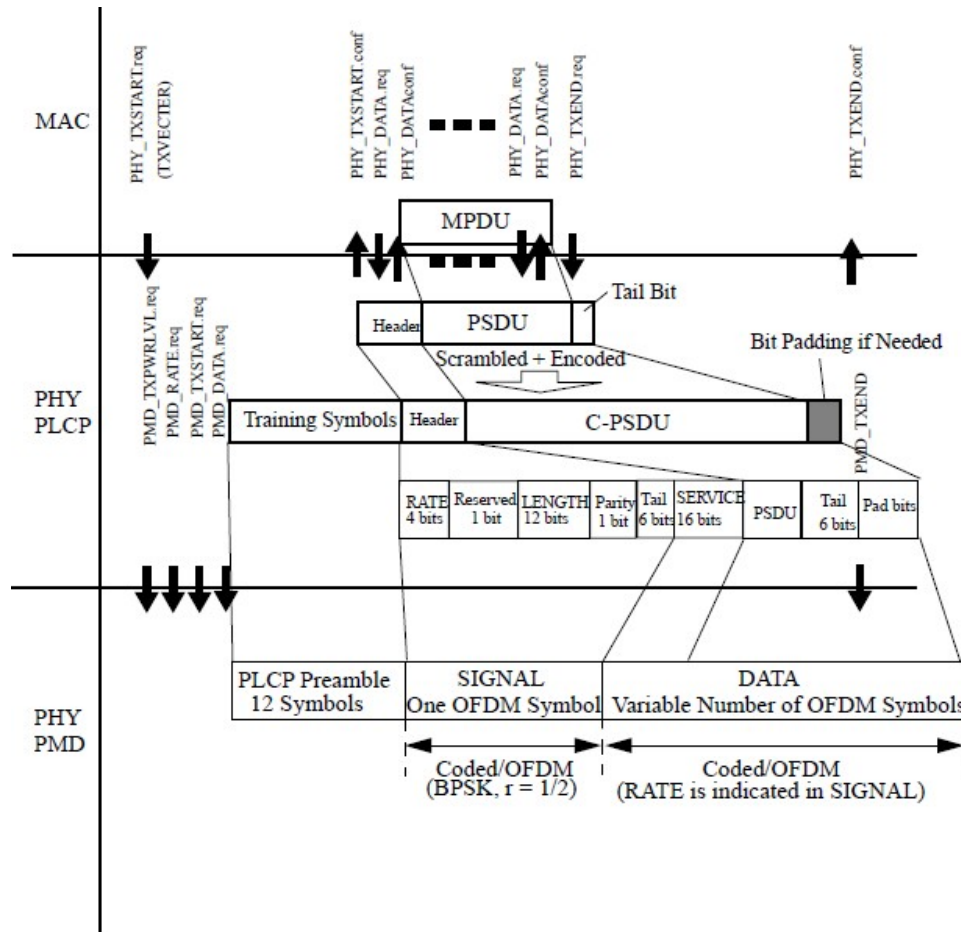


Figure 122—PLCP transmit procedure

b. IEEE 802.11n

69. In 2004, IEEE created the IEEE 802.11n task group (TGn) and charged the group with crafting a standard for WLANs that can sustain up to 100 Mbits/second throughput. This new standard, 802.11n, builds upon previous 802.11 standards, especially 802.11a. Two competing proposals emerged during the deliberations of TGn^{3/4} a proposal from the World-Wide Spectrum Efficiency (WWiSE) group and a proposal from the TGn Sync group. As discussed in further detail in §IV.A.1., the TGn Sync proposal included support for an extended

physical layer header. The WWiSE proposal included support for an extended range mode which duplicates (repeats) the physical layer header. (*See*, §IV.A.1.)

B. Level Of Ordinary Skill In The Art

70. I understand that certain issues relating to the validity of the '146 patent must be judged from the perspective of a person of ordinary skill in the relevant art, as I discuss below. I have been asked to define the level of a “person of ordinary skill in the art” or “POSITA” at the time the alleged invention was made. In deciding the level of ordinary skill, I have considered the following factors, which I have been informed are relevant to the determination of ordinary skill in the art:

- the level of education and experience of persons working in the field;
- the types of problems encountered in the art;
- the prior art solutions to these problems;
- the rapidity with which innovations are made; and
- the sophistication of the technology.

71. In my opinion, a person of ordinary skill in the art (“POSITA”) at the time of the purported invention described in the '146 patent would have had at least a master's degree in electrical engineering or similar discipline, and/or two to three years of experience working or conducting research in the field of wireless communication protocols, or an equivalent combination of education and

experience. My opinion below explains how a POSITA would have understood the technology described in the references identified in this declaration as of the priority date of the '146 patent.

C. Claim Construction

72. I understand that “claim construction” is the process of determining a patent claim’s meaning. I understand that the Patent Office applies the same claim construction standard used in district courts which seeks to give claim terms their plain and ordinary meaning to a POSITA at the time of the claimed invention in view of the claims, specification, and prosecution history. I also understand that if the patent applicant gave a term a special meaning in the specification or during prosecution, then the special meaning should be used.

73. I do not believe that any terms require explicit construction. Therefore, I apply the plain and ordinary meaning to the recited claim terms.

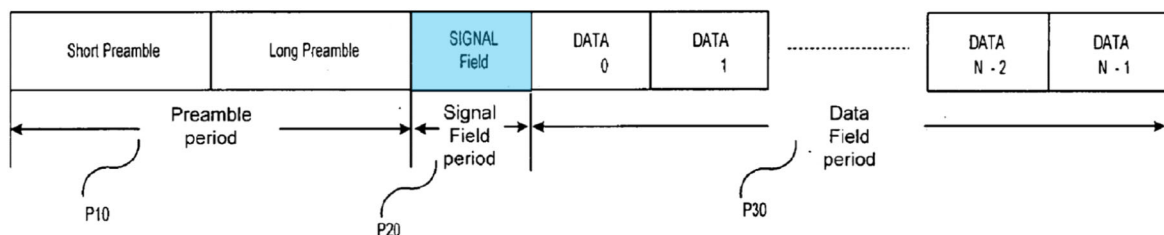
III. GROUND 1: Claims 1-10 are Obvious Based On Yu.

A. Yu Overview

74. Yu is the May 24, 2007 publication of U.S. Patent Application 11/635,927, which matured into U.S. Patent No. 7,839,760 (DELL-1017; “Yu”). Yu relates “to an orthogonal frequency division multiplexing wireless local area network (LAN) transmitting/receiving system for providing expanded service coverage.” (DELL-1017, Abstract.) Yu describes its invention in the context of the

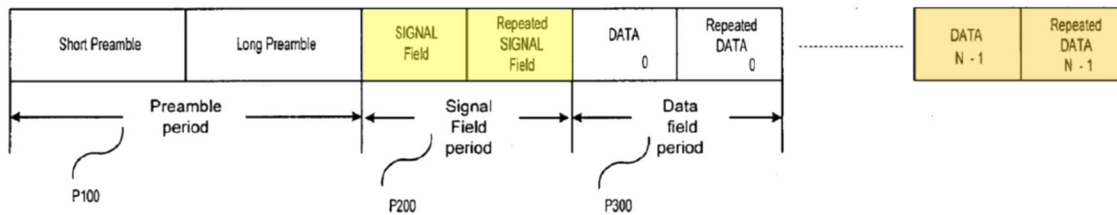
IEEE 802.11a and 802.11g wireless LAN standards, which Yu sought to extend by adding new signaling modes with “high receiving sensitivity and wider coverage” while “providing compatibility with a conventional system.” (DELL-1017, ¶¶ 21–22.) In other words, Yu expanded the range for 802.11a/g networks while maintaining backward compatibility by adding an expanded range signaling mode in which the “SIGNAL” header field and data fields of a packet/frame are repeated to increase communication range (“service radius”) by “50% to 100%,” at the expense of cutting the transmission speed in half. (DELL-1017, ¶¶ 24–28, 80.)

75. As Yu explains, legacy 802.11a-type frames do not include repeated header SIGNAL or data fields, which limits effective transmission range to “approximately 100m.” (DELL-1017, ¶17.) Figure 2, reproduced below, illustrates such a legacy frame. As shown, “the preamble period P10 includes a short preamble and long preamble,” and the “signal field of the signal field period P20 has transmission mode information (i.e., modulation method and code rate information) and frame length information.” (DELL-1017, Fig. 2, ¶¶ 10–15.)



Yu, Figure 2²

76. Yu's solution for increasing transmission range was to repeat the SIGNAL and data fields to form an expanded range packet/frame. The expanded range packet format in Yu's Figure 7 (below) includes "preamble period P100 [that] is the same as that of the conventional wireless LAN frame shown in FIG. 2" except the "signal field period P200 and the data field period P300 [that] are repeated." (DELL-1017, ¶83.)

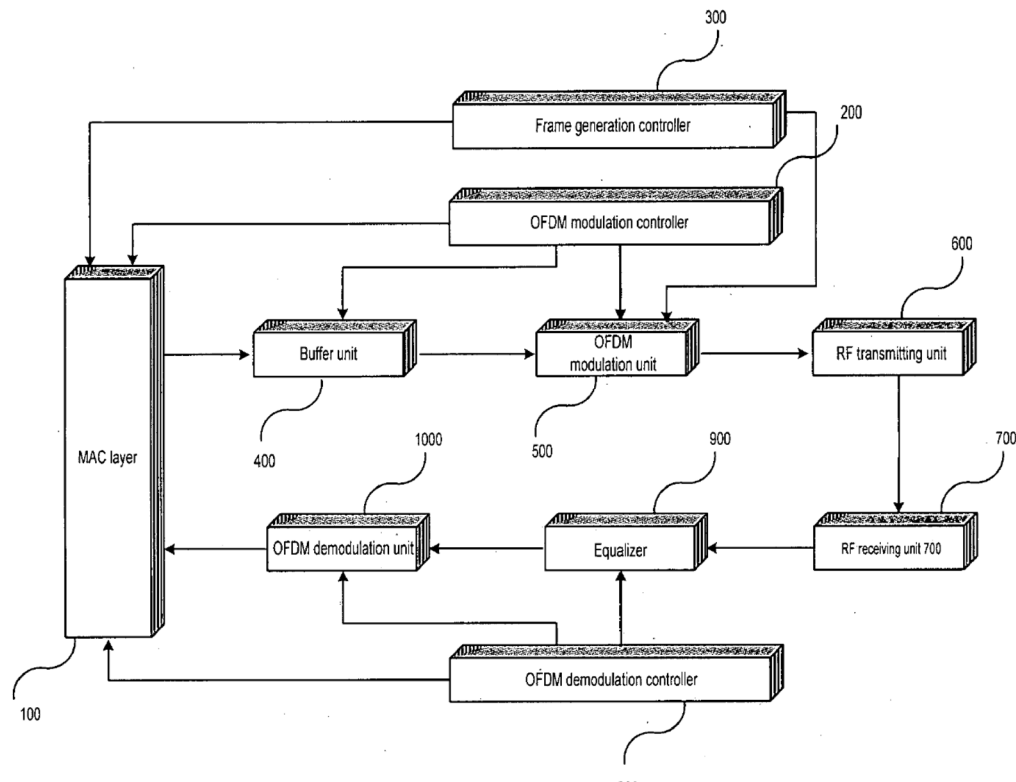


Yu, Figure 7

As shown, the main difference between the normal range 802.11a packet format (Figure 2) and Yu's expanded range packet format (Figure 7) is that the expanded range packet includes repeated SIGNAL and DATA fields (colored yellow and orange, respectively).

77. Yu also describes a "wireless LAN transmitting/receiving system" for packets having both conventional (normal range) and expanded range formats. (DELL-1017, Fig. 3.)

² Annotations and emphases have been added throughout this petition unless otherwise noted.

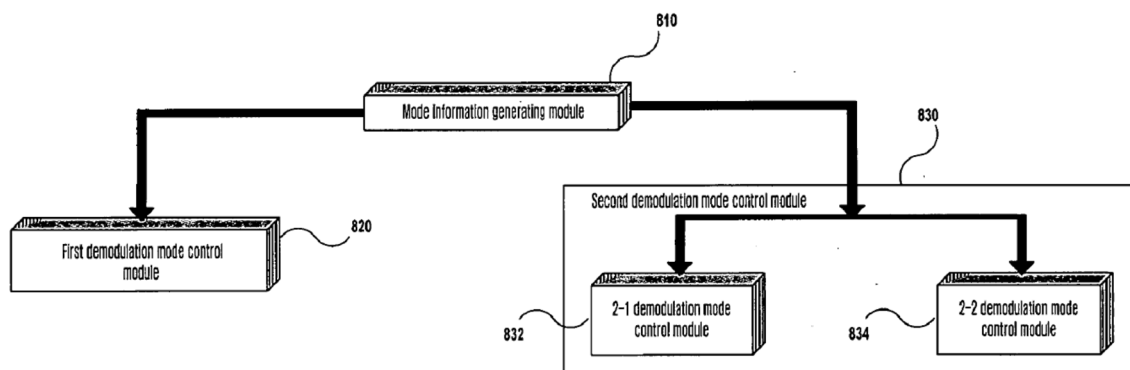


Yu, Figure 3

78. For receiving frames, Yu describes “RF receiving unit 700,” “OFDM demodulation controller 800,” “equalizer 900,” and “OFDM demodulation unit 1000.” (DELL-1017, ¶46.) “OFDM demodulation controller 800 determines whether a received frame includes repeatedly modulated OFDM symbols, and controls an operation of a demodulation mode according to a determination result.” (DELL-1017, ¶53.) “[E]qualizer 900 performs an equalization operation for each demodulation mode according to the determination result on whether the received frame includes the repeatedly modulated OFDM symbols.” (DELL-1017, ¶54.) And “OFDM demodulation unit 1000 demodulates the signal field of the received frame for each demodulation mode determined according to whether the received

frame includes the repeatedly modulated OFDM symbols.” (DELL-1017, ¶55.)

79. As shown in Figure 5 below, Yu’s OFDM demodulation controller 800 includes “mode information generating module 810,” which “generates demodulation mode information according to the determined result on whether the received frame includes the repeated signal fields.” (DELL-1017, ¶67.) “The first demodulation mode control module 820” controls the demodulation of normal-range packets, which are detected by the mode information generating module 810 because they lack a repeated signal field. (DELL-1017, ¶68.) Conversely, the “second demodulation mode control module 830” controls the demodulation of the expanded range packets detected by the mode information generation module based on a repeated signal field. (DELL-1017, ¶69.)



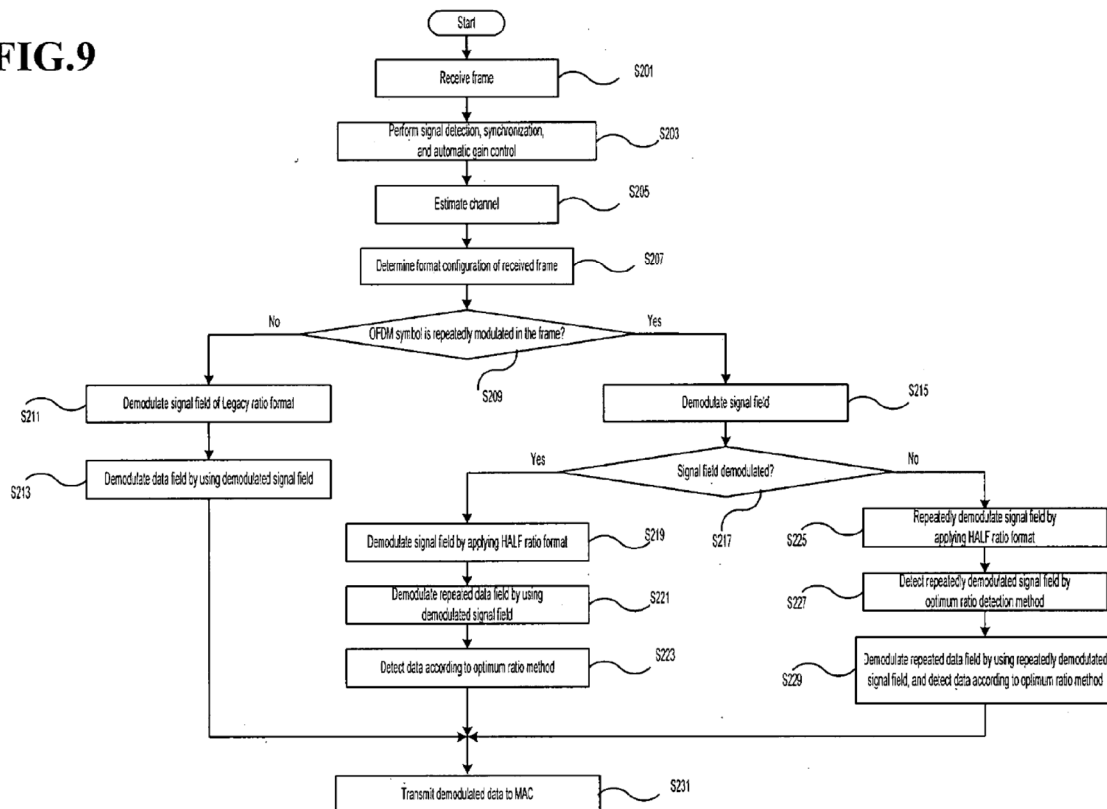
Yu, Figure 5

80. Yu additionally includes a flow diagram in Figure 9 that describes the receive process for the frame formats in Figures 2 and 7. In steps S207 and S209 “a format configuration of the received frame is determined” to allow the selection

of “a demodulation mode of the frame in which the signal field is not repeated, or a demodulation mode of the frame in which the signal field is repeated.”

(DELL-1017, ¶102.) Steps S207 and S209 correspond to mode information generating module 810 of Figure 5, which “generates demodulation mode information according to the determined result on whether the received frame includes the repeated signal fields.” (DELL-1017, ¶67.)

FIG.9



If it is determined at steps S207 and S208 that the frame does not include a repeated signal field, control follows to the left branch in the flow diagram, and the frame is demodulated as a conventional, normal range frame. (DELL-1017, ¶103.) On the other hand, “when it is determined in step S209 that the signal field is repeatedly

generated in the frame (i.e., the OFDM symbol is repeatedly modulated), the signal field is demodulated in step S215.” (DELL-1017, ¶104.) If “the signal field is successfully demodulated” in step S215, control flows down the center branch, and the frame is demodulated as an expanded range frame at a rate that corresponds to the demodulated signal field. (DELL-1017, ¶¶105–106.) “When a failure to demodulate the signal field occurs (i.e., the demodulation may not be performed by one single signal field), the repeated signal field is demodulated in step S225,” and the frame is then demodulated as an expanded range frame at a rate that corresponds to the contents of the demodulated signal field according to the right branch of the flow diagram. (DELL-1017, ¶¶108–109.)

B. Independent Claims 1 and 6

[1P] A wireless communication device, comprising:

[1A] a wireless receiver configured to receive a wireless packet through a communication channel, formats of the wireless packet including a first packet format and a second packet format, the first packet format comprising a first header field carried by a first orthogonal frequency division multiplexing (OFDM) symbol, the second packet format comprising both the first header field carried by the first OFDM symbol and a second header field carried by a second OFDM symbol which follows the first OFDM symbol, and the second header field being a repetition of the first header field; and

[1B] a demodulator configured to demodulate the received wireless packet,

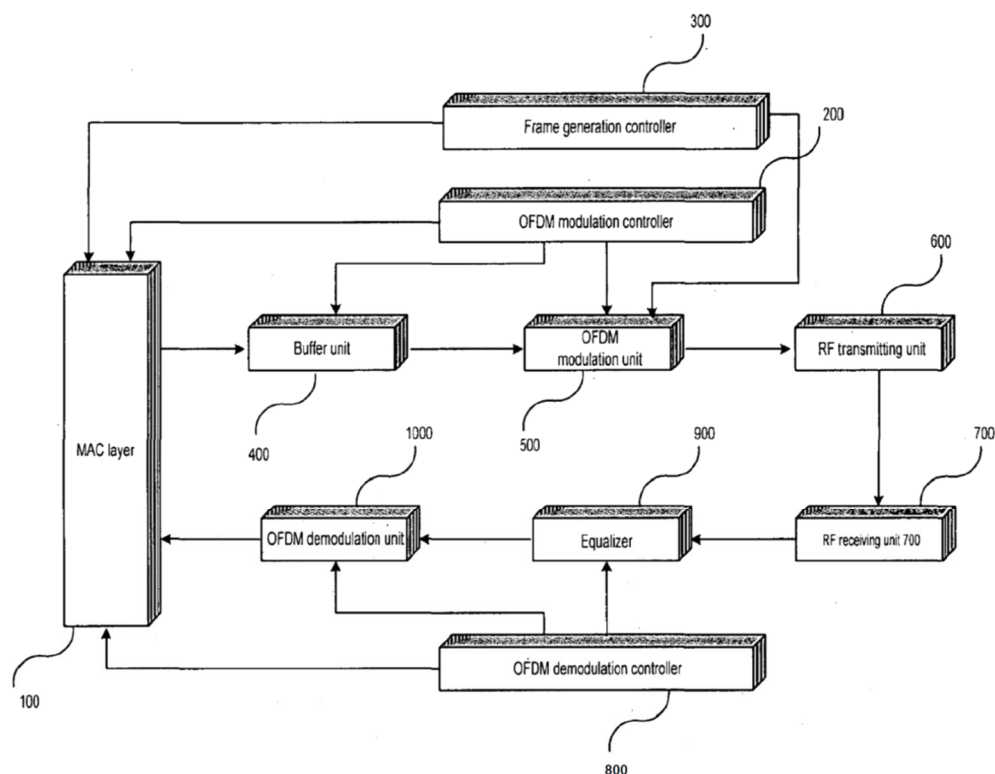
[1C] wherein the wireless receiver distinguishes the second packet format from the first packet format by detecting, from the received wireless packet, the second header field which repeats the first header field.

81. In my opinion, Yu renders these claims obvious, as I have set forth below.

1. Preamble [1Pre] and [6Pre]

82. In my opinion, Yu discloses the preamble. Yu discloses a “wireless LAN transmitting/receiving system” that is “based on OFDM-based IEEE 802.11a/g standards” and would be implemented in, for example, an AP or STA (a “*wireless communication device*”). (See DELL-1017, Fig. 3, ¶44 (“FIG. 3 shows a block diagram of a wireless LAN transmitting/receiving system ...”).)

FIG.3



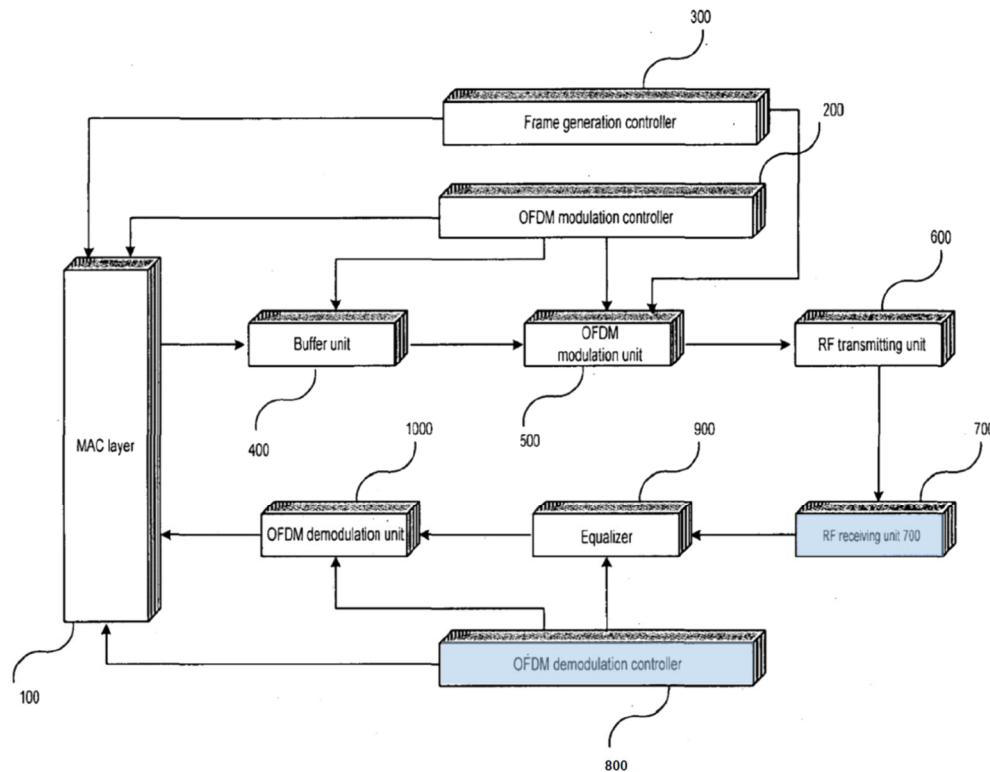
2. Claim Limitations [1A] and [6A]

83. In my opinion, Yu renders these limitations obvious.

a. *A wireless receiver to receive first and second wireless packet formats through a communication channel*

84. Yu's wireless communication device of Figure 3 has "a receiving system" that includes an "OFDM demodulation controller" and a "RF receiving unit" that receives wireless LAN packets. (DELL-1017, ¶46.)

FIG.3



85. Yu's OFDM system is configured "according to the IEEE 802.11a standard" and therefore uses wireless communication channels with subcarriers. (DELL-1013, 24–25 ("17.3.8.3 Operating *channel* frequencies").) Accordingly, Yu teaches a long preamble "for performing fine frequency synchronization and *channel* estimation of each subcarrier" in a wireless OFDM channel. (DELL-1017, ¶13.)

86. Yu's receiving system is further adapted to receive frames in two different formats, including a "conventional" format ("*first packet format*") shown in Figure 2 with only one "SIGNAL" field (shaded blue), and a format as shown in Figure 7 ("*second packet format*") with a repeated SIGNAL field (shaded yellow) and a repeated DATA field.

FIG.2

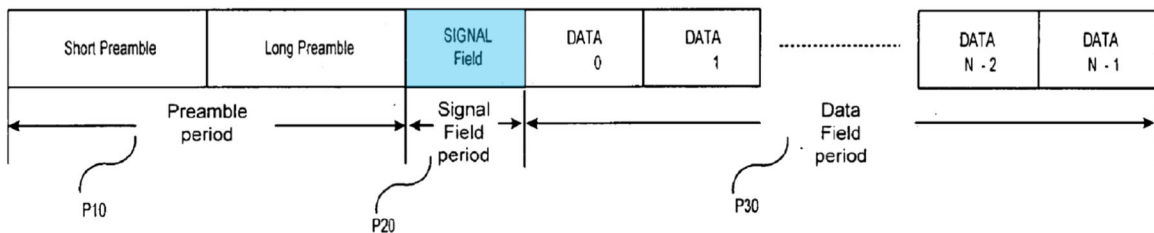
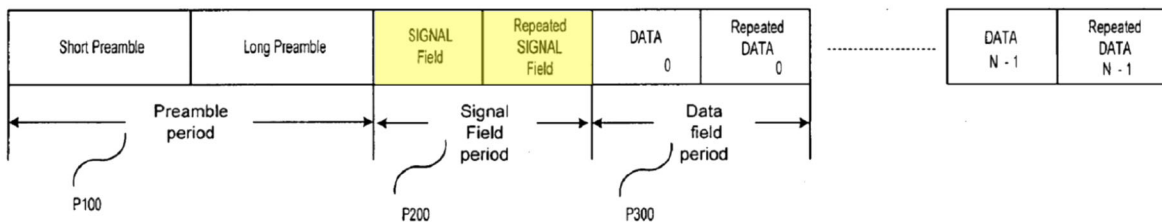


FIG.7



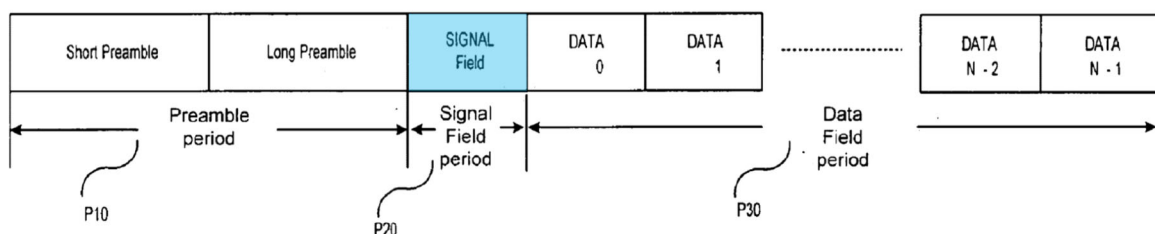
(DELL-1017, Fig. 2.) In both formats, the signal field precedes the payload and includes "transmission mode information (i.e., modulation method and coding rate information) and frame length" (DELL-1017, ¶14.) A POSITA would therefore have considered the SIGNAL and "Repeated SIGNAL" fields to be header fields. (DELL-1003, ¶86.) Furthermore, although Yu does not use the term "packet," a POSITA would have understood that Yu's "frame" corresponds to an

802.11 packet. Yu expressly describes a “wireless LAN system according to the IEEE 802.11a standard” (DELL-1017, ¶7), and the IEEE 802.11a standard uses the term “frame” when describing packets. (See, e.g., DELL-1013, 7 (describing the “PLCP *frame* format,” illustrating the “PPDU *frame* format” in Figure 107, and explaining that “[t]he RATE and LENGTH” in the frame header “are required for decoding the DATA part of the *packet*”).)

b. First packet format comprises a first header field carried by a first OFDM symbol

87. Although Yu does not use the term “header,” the frame format in Figure 2 includes a “SIGNAL” field (blue) that a POSITA would have recognized as a “*header field*” because it precedes the data payload and contains “modulation method and code rate” and “frame length information” for decoding the frame data. (DELL-1017, ¶14, Fig. 2.)

FIG.2



Furthermore, as noted above (*supra* §III.B.2.a), Yu describes a “wireless LAN system according to the IEEE 802.11a standard” (DELL-1017, ¶7), which describes an analogous SIGNAL field in the “PLCP Header” of the “PPDU frame

format,” confirming that Yu’s SIGNAL is a header field. (DELL-1013, 7, Fig. 107.)

88. A POSITA reading Yu would also understand that the SIGNAL field is carried by an OFDM symbol within Yu’s “OFDM wireless LAN.” (*See* DELL-1017, ¶25 (describing “OFDM symbol modulation” and “demodulation” in “[a]n exemplary receiving system of an OFDM wireless LAN according to an embodiment of the present invention”), ¶49 (same); ¶104 (explaining that the signal field can be “repeatedly generated in the frame (i.e., the OFDM symbol is repeatedly modulated) ...”).) To the extent Yu does not teach that the SIGNAL field is carried by a single OFDM symbol, Petitioner does not believe that is a requirement of the claim, but it nevertheless would have been obvious to a POSITA to implement Yu’s SIGNAL field in a single OFDM symbol as described in the IEEE 802.11a standard, which incorporates the SIGNAL field into “One OFDM Symbol” as shown in green in Figure 107 below. (DELL-1013, 7, Fig. 107.)

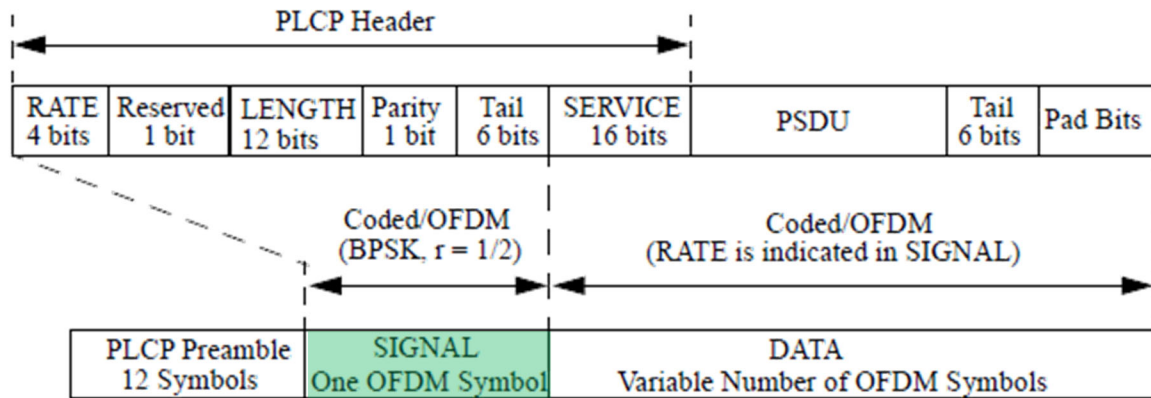


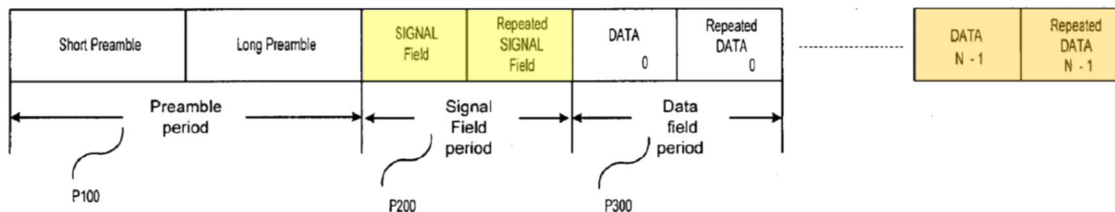
Figure 107—PPDU frame format

A POSITA would have had a reasonable expectation of success in implementing Yu’s SIGNAL field as a single OFDM symbol since Yu’s system is expressly designed to be compatible with the IEEE 802.11a standard (DELL-1017, ¶7), and Yu’s SIGNAL field includes the same kind of information as the SIGNAL symbol of the 802.11a standard (*compare* DELL-1017, ¶14 with DELL-1013, 7, Fig. 107).

- c. *Second packet format comprises the first header field carried by the first OFDM symbol and a second header field carried by a second OFDM symbol that repeats the first*

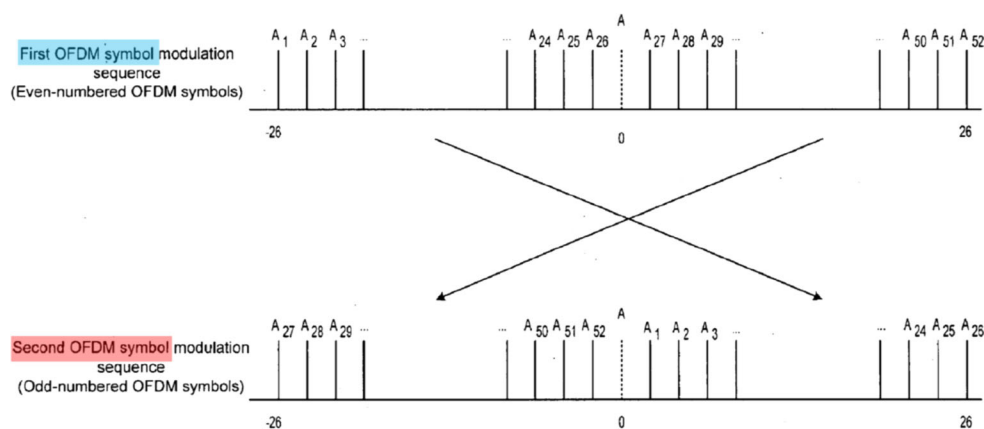
89. Yu discloses a second expanded service area packet format as shown in Figure 7 below. This packet has the same format as the conventional packet format of Figure 2 except that “[i]n the signal period P200, *the signal field is repeated,*” and the data is likewise repeated. (DELL-1017, ¶83.) As discussed above, a POSITA reading Yu would have understood that the signal field is in the header and carried by a first OFDM symbol (*supra* §III.B.1), so when it is repeated

in the expanded service area packet format, the repeated SIGNAL header field is carried by a second OFDM symbol. (DELL-1017, Fig. 7.)



This is confirmed in Yu’s Figure 6, which shows the subcarrier assignments for the packet format of Figure 7, including that each of the repeated signal fields is carried by an OFDM symbol. (DELL-1017, Fig. 6, ¶74 (“FIG. 6 shows a diagram representing the repeated *OFDM symbols* of the wireless LAN transmitting system according to the exemplary embodiment of the present invention.”); DELL-1003 ¶89.)

FIG.6



Yu explains that “an input OFDM symbol is transmitted for the even-numbered time to form a *first OFDM symbol* modulation sequence,” after which “the OFDM symbol transmitted during the even-numbered time is repeated, and a subcarrier

location is circulated by $\frac{1}{2}$ of the FFT point to transmit the OFDM symbol, which forms a ***second OFDM symbol*** modulation sequence.” (DELL-1017, ¶77.)

Accordingly, Figure 6 shows “data A1 to A52 and a pilot symbol are allocated to subcarriers -26 to -1 and 1 to 26,” and “in the next repeated OFDM symbol, data A27 to A52 are allocated to subcarriers -26 to -1, and data A1 to A26 are allocated to subcarriers 1 to 26.” (DELL-1017, ¶78.) Yu thus discloses that in the expanded service area packet format (“*second packet format*”), the “SIGNAL” field (“*first header field*”) is “*carried by the first OFDM symbol*,” and the “Repeated SIGNAL Field” (“*a second header field ... that repeats the first*”) is “*carried by a second OFDM symbol*.”

3. Claim Limitations [1B] and [6B]

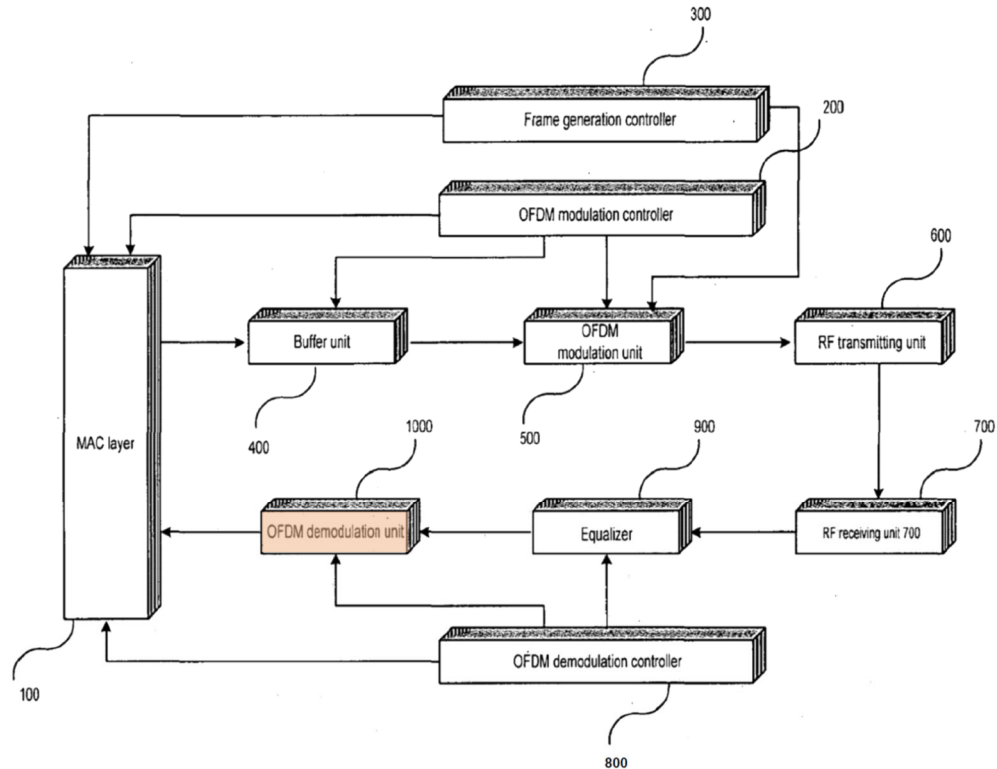
90. In my opinion, Yu discloses these limitations.

a. *Demodulator to demodulate the received wireless packet*

91. Yu discloses an “OFDM demodulation unit 1000” that “demodulates the signal field of the received frame for each demodulation mode ...”

(DELL-1017, ¶55, Fig. 3.)

FIG.3



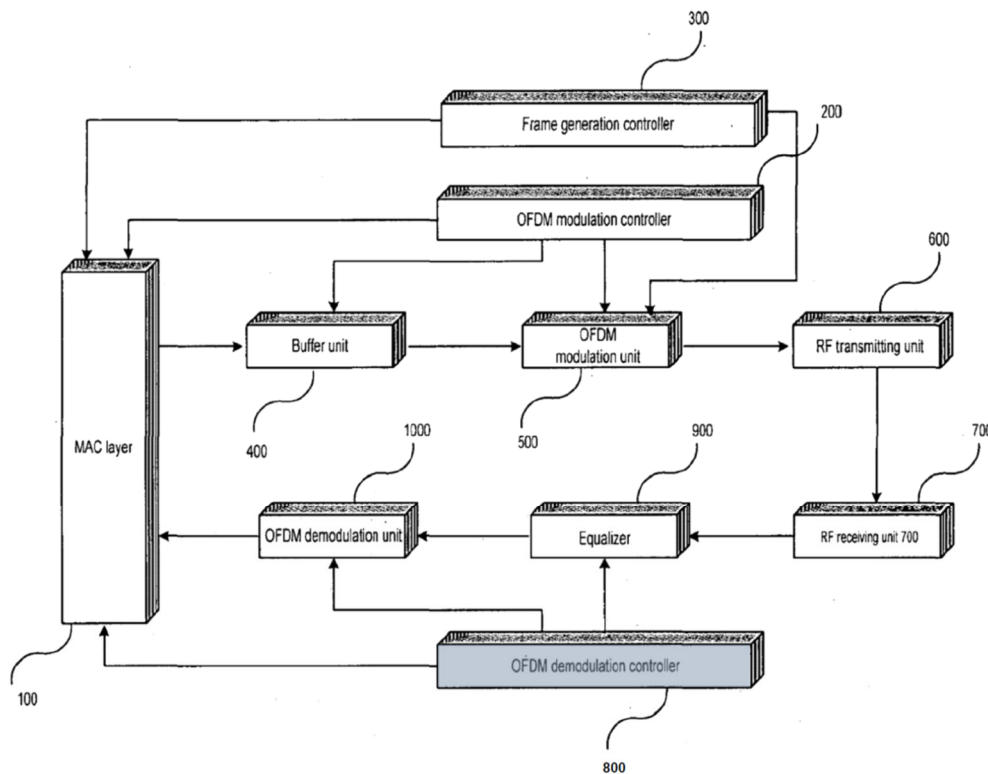
92. The OFDM demodulation unit operates under the control of the “OFDM demodulation controller 800” to determine “whether a received frame includes repeatedly modulated OFDM symbols, and controls an operation of a demodulation mode according to a determination result.” (DELL-1017, ¶53, Fig. 3.) “[W]hen receiving the frame having the format configuration shown in FIG. 7 and obtaining the SNR for *demodulating the frame*, the conventional wireless LAN system *demodulates* the signal field.” (DELL-1017, ¶90; *see also* DELL-1017, ¶25 (“The OFDM demodulation controller determines whether OFDM symbol modulation is repeated in a format configuration of a received frame, and controls a demodulation mode according to a determined result.”).)

4. Claim Limitations [1C] and [6C]

93. In my opinion, Yu discloses these limitations.

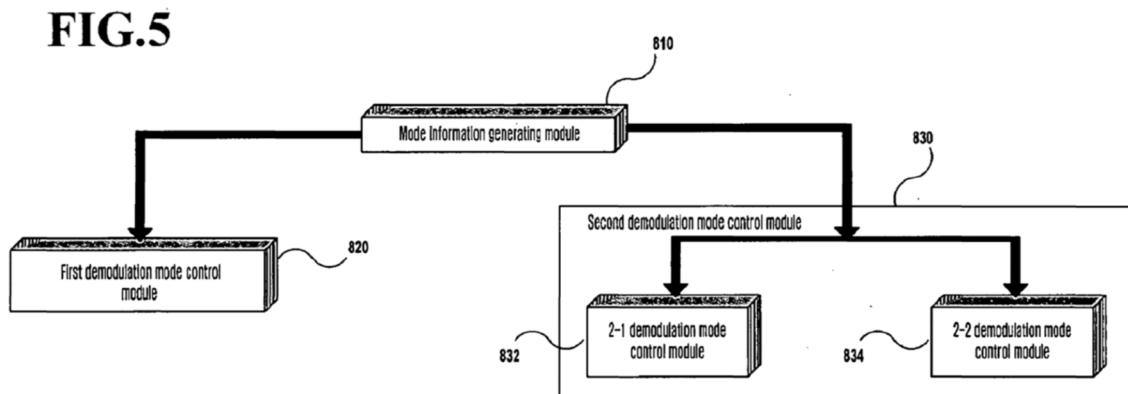
94. Yu's receiver includes "OFDM demodulation controller 800" that "determines whether a received frame includes repeatedly modulated OFDM symbols, and controls an operation of a demodulation mode according to a determination result." (DELL-1017, ¶53, Fig. 3.)

FIG.3

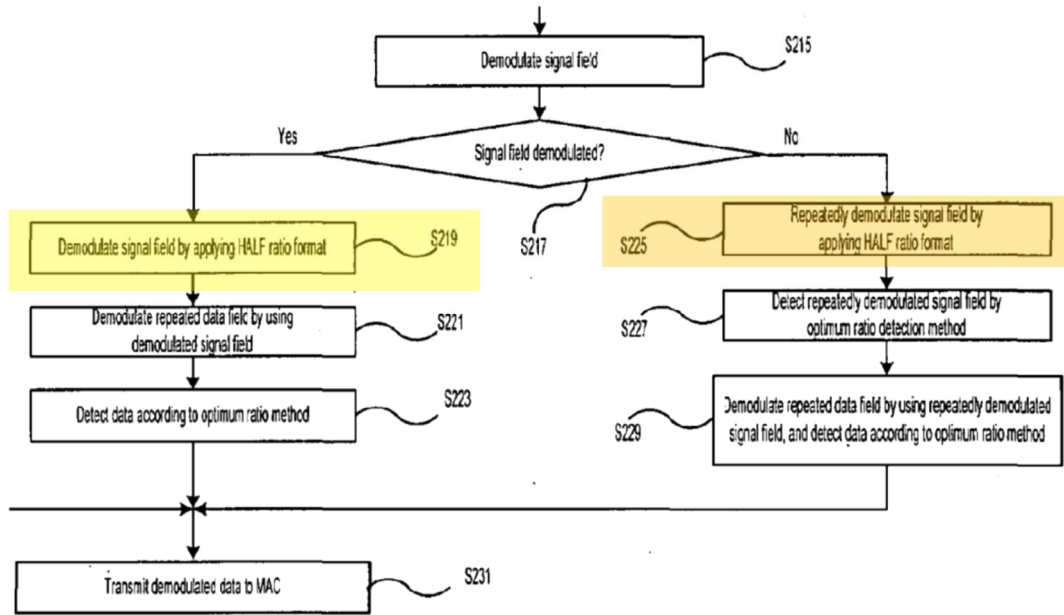


95. "The OFDM demodulation unit" within the receiver then "demodulates the signal field of the received frame for each demodulation mode determined according to whether the received frame includes the repeatedly modulated OFDM symbols." (DELL-1017, ¶¶53, 55.)

96. “As shown in FIG. 5, the OFDM demodulation controller 800 includes a mode information generation module 810” that “generates the demodulation mode information according to the determined result on whether the received frame includes the repeated signal fields.” (DELL-1017, ¶¶66–67, Fig. 5.)



97. The packet/frame “receiving method” shown in Figure 9 determines the “format configuration of the received frame” at step S207 and selects one of the “demodulation mode[s]” depending on whether “the signal field is repeated” in the received frame. (DELL-1017, ¶102.)



98. In the left pathway of excerpt from Figure 9 above, the first copy of the SIGNAL header is successfully demodulated. (DELL-1017, ¶106.) In the right pathway of the excerpt from Figure 9 above, the second copy of the SIGNAL field is used because the first copy was not successfully demodulated. (DELL-1017, ¶108.) In this manner, the receiver detects an expanded service area packet when the system detects the existence of the repeated SIGNAL header in steps S207 and S209, and then demodulation proceeds based on how the repeated SIGNAL header is handled in steps S215 and S217. Yu thus teaches distinguishing between the packet formats of Figures 2 and 7 based on detecting the second SIGNAL field which repeats the first SIGNAL field.

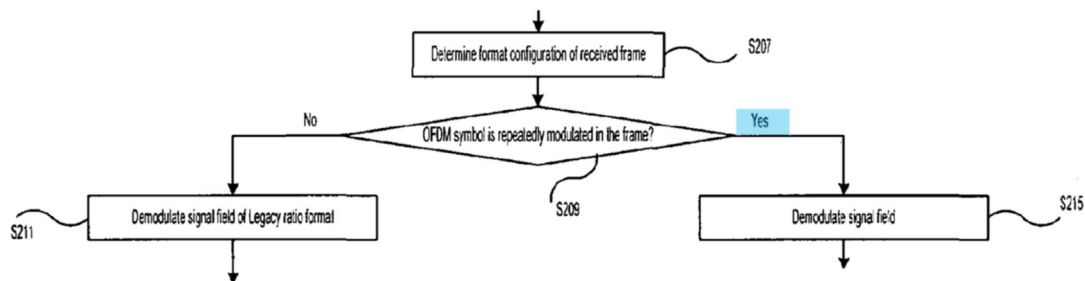
C. Claims 2 and 7

[2] The wireless communication device of claim 1, wherein the wireless receiver determines the received wireless packet as the second

packet format when the second header field is detected from the wireless packet.

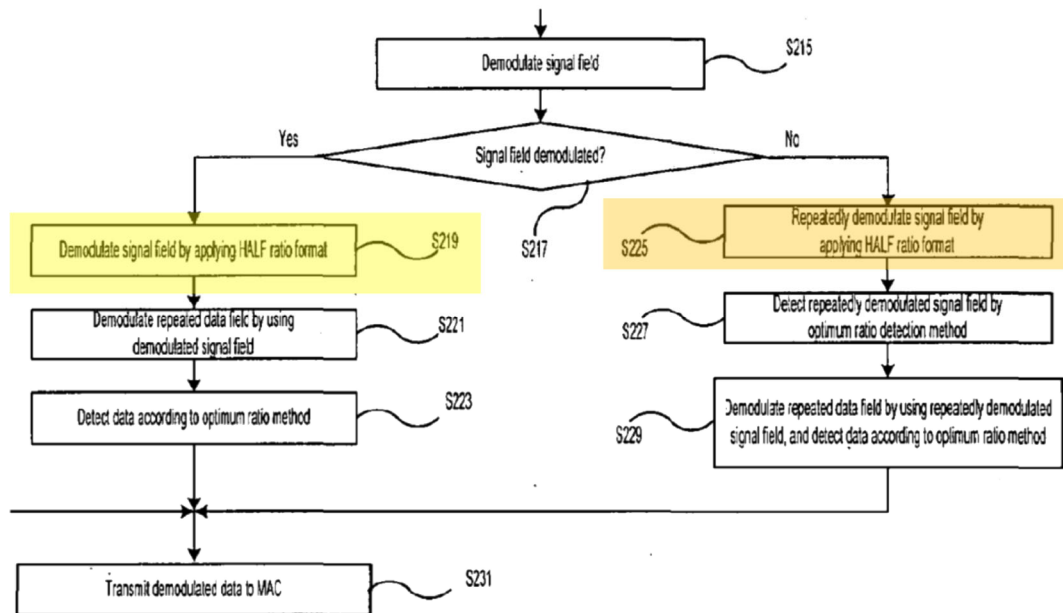
99. In my opinion, Yu discloses these limitations.

100. As I have discussed above in §III.B.4., *supra*, Yu’s receiver determines the format of the received frame by detecting the presence of a repeated signal field, and selects the demodulation mode accordingly. (DELL-1017, ¶¶53–55.) Yu determines whether “the signal field is repeatedly generated in the frame (i.e., the OFDM symbol is repeatedly modulated),” and demodulates the signal field accordingly. (DELL-1017, ¶¶102–104.) As shown in the excerpt of the process of Figure 9 below, when the decision of step S209 is in the affirmative (shaded blue)—i.e., the repeated signal field is detected—the receiver determines the format is the second format of Figure 7 and demodulates the signal field accordingly.



101. In this case, the “second demodulation mode control module 830” is used to control the demodulation operation of the received frame. (DELL-1017, ¶69.) Module 830 uses the “bit allocation information” of the repeated OFDM symbols (e.g., as shown in Figure 7) to demodulate the received frame by applying

a half ratio format according to steps S219 or S225 of the receiving process of Figure 9. (DELL-1017, ¶69, Fig. 7.)



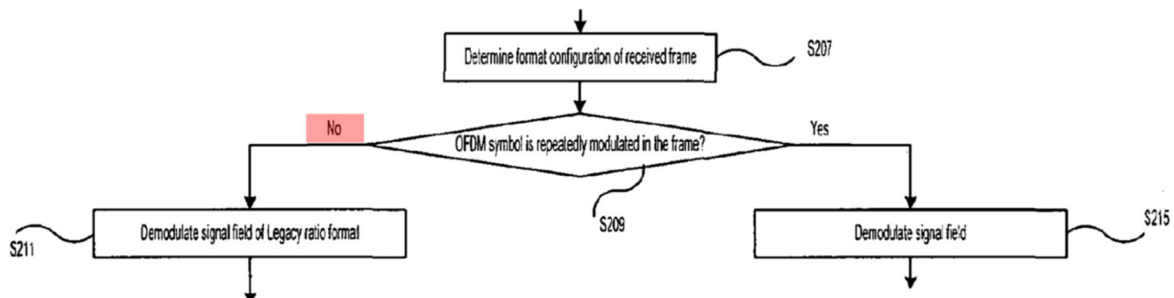
As I have discussed above, demodulation of the packet then follows either the left or right pathway in the above excerpt from Figure 9. In the left pathway, the first copy of the SIGNAL header is successfully demodulated. (DELL-1017, ¶106.) In the right pathway, the second copy of the SIGNAL field is used because the first copy was not successfully demodulated. (DELL-1017, ¶108.) In this manner, the receiver detects an expanded service area packet when the system detects the existence of the repeated SIGNAL header in steps S207 and S209, and then demodulation proceeds based on how the repeated SIGNAL header is handled in steps S215 and S217. In both instances, however, the second header field is required for the determination.

D. Claims 3 and 8

[3] The wireless communication device of claim 1, wherein the wireless receiver determines the received wireless packet as the first packet format when the second header field is not detected from the wireless packet.

102. In my opinion, the combination of Yu and 802.11a-1999 discloses these limitations.

103. As I have discussed above in §II.B.4., *supra*, Yu’s receiver determines the format of the received frame by detecting the presence of a repeated signal field and selects the demodulation mode accordingly. (DELL-1017, ¶¶53–55.) Yu determines whether “the signal field is repeatedly generated in the frame (i.e., the OFDM symbol is repeatedly modulated),” and demodulates the signal field accordingly. (DELL-1017, ¶¶102–104.) As shown in the excerpt of the process of Figure 9 below, when the decision of step S209 is in the negative (shaded red)—*i.e.*, the repeated signal field is ***not*** detected—the receiver determines the format is the first format of Figure 2 and demodulates the signal field accordingly.



104. In this case, the “first demodulation mode control module 820” is used to control the demodulation operation of the received frame (DELL-1017, ¶¶68) and

“the demodulation is performed by using a Legacy ratio format ...” (DELL-1017, ¶103) according to step S211 of the receiving process shown in Figure 9.

E. Claims 4 and 9

[4] The wireless communication device of claim 1, wherein the first and second header fields contain information for decoding the wireless packet.

105. In my opinion, Yu discloses these limitations.

106. As I have discussed above in §III.B.2.b., the signal fields are header fields because they “*contain information for decoding the wireless packet.*” The signal field contains the “modulation method and code rate” and “frame length information” that a POSITA would understand constitutes “important control information for the receiver to decode the payload properly” in accordance with the description of a packet “header” in the specification. (DELL-1017, ¶14; DELL-1001, 1:43–46.)

F. Claims 5 and 10

[8] The wireless communication device of claim 1, wherein the first and second header fields contain information related to a length of the wireless packet.

107. Yu discloses these limitations. As I have discussed above in §III.B.2.b., *supra*, the signal field contains “frame length information” which is “*information related to a length of the wireless packet.*” (DELL-1017, ¶14.)

IV. GROUND 2: Claims 1–10 Are Obvious Based On the Combination of Hansen and WWiSE

108. As I set forth below, the proposed combination involves programming Hansen’s 802.11-compliant, wireless OFDM transceivers to support WWiSE’s packet formats—including extended range (ER) packets—within WWiSE’s WLAN.

A. Combination Overview

109. In 2002, “discussions began in the IEEE 802.11 Working Group (WG) to extend the data rates of the physical layer beyond those of IEEE 802.11a/g in order to address higher throughput wired applications that would benefit from the flexibility of wireless connectivity.” (DELL-1018, 48.) In September of that year, the IEEE formed a High Throughput (HT) Study Group (SG) to, among other things, work “on usage model development, channel model development, and selection procedures” for a new extension to 802.11a/g. (DELL-1018, 49.) A year later, an 802.11n Task Group (TGn) was formed to continue this work and “to develop an amendment to the IEEE 802.11 standard (i.e., IEEE 802.11n).” (DELL-1018, 48–49.) TGn began by defining “functional requirements and comparison criteria” for 802.11n, including usage models that “were to be relevant to the expected uses of the technology,” where “[e]ach usage model contained an access point (AP) and a defined number of stations running a mix of applications based on the use cases.” (DELL-1018, 49–50.) Other key

requirements included “the capability of at least 100 Mb/s MAC throughput” and “interoperability between 802.11a/g and 802.11n.” (DELL-1018, 51–52.) After defining the requirements and criteria, TGn issued a call for proposals in May 2004. (DELL-1018, 50.)

110. In total, TGn received five complete proposals for consideration in 802.11n: three from individual companies, and two from consortia of companies—“TGn Sync (started by Intel, Cisco, Agere, and Sony) and WWiSE (started by Broadcom, Conexant, Texas Instruments, and Airgo Networks.” (DELL-1018, 50.) “The basic features and technologies in the various proposals were actually the same. All proposals included MIMO, 40 MHz bandwidth channels, frame aggregation, and enhanced block acknowledgement. For the most part, the difference between the proposals was the implementation details of these features.” (DELL-1018, 50.) For example, TGn Sync’s proposal provided a mechanism for “mixed mode” access by legacy devices (*i.e.*, devices that supported 802.11a/g) but not a mechanism for “greenfield” access in “environments free from legacy devices” such that “backward compatibility is not required.” (DELL-1011, 14; DELL-1018, 53.) The WWiSE proposal, on the other hand, provided mechanisms to support *both* greenfield and mixed mode access. (DELL-1005, 58-60.) After considerable negotiation, TGn ultimately approved a joint proposal that incorporated elements from both TGn Sync and WWiSE in January 2006.

(DELL-1018, 50.)

1. Hansen

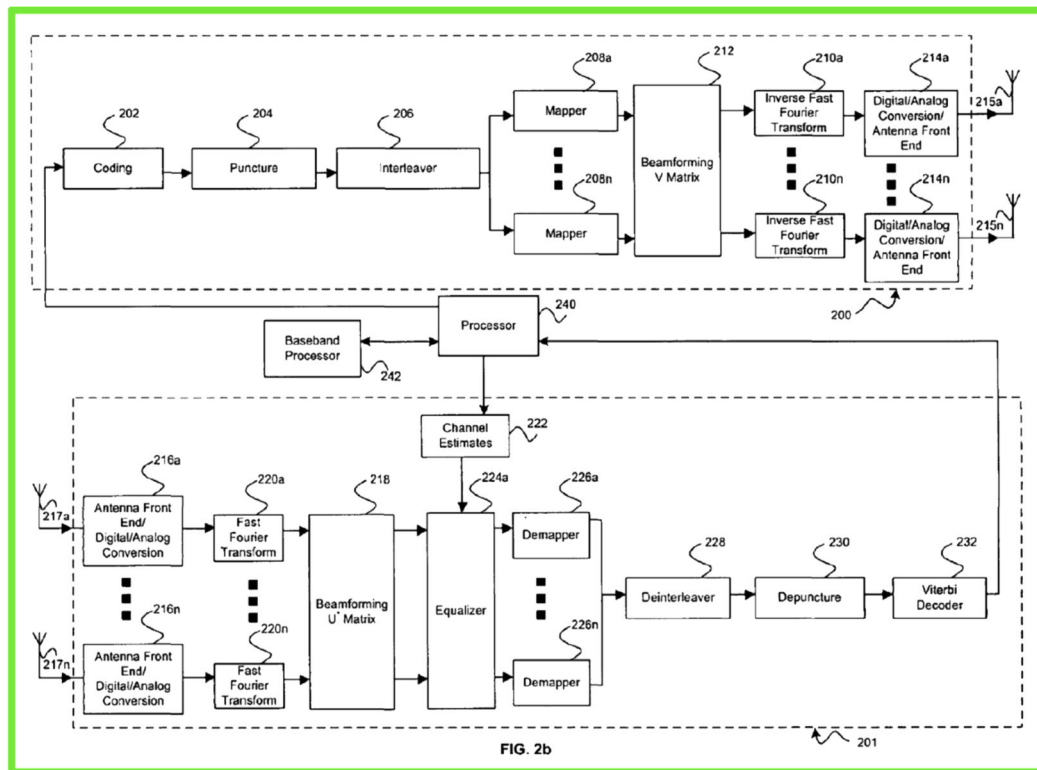
111. Hansen is the publication of U.S. Patent Application 11/151,772, which matured into U.S. Patent 8,737,189 (DELL-1009; “Hansen Patent”). Hansen relates “to a method and system for compromise greenfield preambles for 802.11n.” (DELL-1006, ¶7, 1:24–25.)

112. In particular, Hansen sought a compromise between the TGn Sync and WWiSE proposals discussed above by combining aspects of the mixed-mode TGn Sync preambles and headers with greenfield preambles and headers proposed by the WWiSE industry group during development of 802.11n. (DELL-1006, ¶¶7, 11, 27, Fig. 4a, Fig. 5a, Fig. 6a; DELL-1010, 14; *see also* DELL-1006, ¶¶1, 6 (incorporating the Hansen Prov. by reference).) In the corresponding Hansen Patent, Hansen submitted the WWiSE proposal from January 2005 (“January 2005 WWiSE”) and the TGn Sync proposal from January 2005 in an Information Disclosure Statement. (*See* DELL-1009, (56) OTHER PUBLICATIONS.) Petitioner refers to the WWiSE proposal discussed in Hansen as “January 2005 WWiSE” to distinguish it from the March 2005 version of the WWiSE proposal applied in this ground (DELL-1005).

113. Hansen also describes transceiver hardware, illustrated in Figure 2b, that “may be utilized in accordance with an embodiment of the invention.”

(DELL-1009, 2:12-13; DELL-1006, ¶¶15, 29, 41, 57.)

Wireless OFDM Transceiver



2. WWiSE

114. WWiSE was a proposal submitted to the TGN working group in July 2005 that built upon an earlier January 2005 WWiSE proposal. (DELL-1005, 1.) WWiSE proposed HT extensions to the existing 802.11 standard to double the bandwidth from previous versions of 802.11 by providing a 40 MHz frequency band for HT device communications or two 20 MHz frequency bands—which WWiSE referred to as “channels”—for devices that did not support the 40 MHz band (*e.g.*, legacy 802.11 devices). (*See, e.g.*, DELL-1005, 13-14, 48-49, 84.)

115. WWiSE also added PHY specifications for ER operation for

improved reliability in conditions where an 802.11-compliant device operates at the edge of the wireless range of an AP or STA. (See, e.g. DELL-1005, 50, 67-69.)

ER-capable devices support both an Extended Range Modulation and Coding Scheme (MCS) and a Normal Range MCS as well as the long SIG-N field format in the PPDU. (DELL-1005, 50:9-10.) In the extended communication range configuration (ER), “SIG-N is composed of two consecutive MIMO-OFDM symbols: The SIG-N MIMO-OFDM symbol is followed by a second MIMO-OFDM symbol, denoted as ER-SIG-N.” (DELL-1005, 69:16-18.) To support ER capability, the SIGNAL-N field includes a REXT field indicating whether standard or extended range communication is being used for transmission. (DELL-1005, 69-70.)

116. The following figure illustrates a mixed mode ER PPDU for two spatial streams ($N_{TX} = 2$) at 20 MHz. The shaded field “indicates the optional duplicate SIG-N for extended range communication.” (DELL-1005, 68:1-4.)

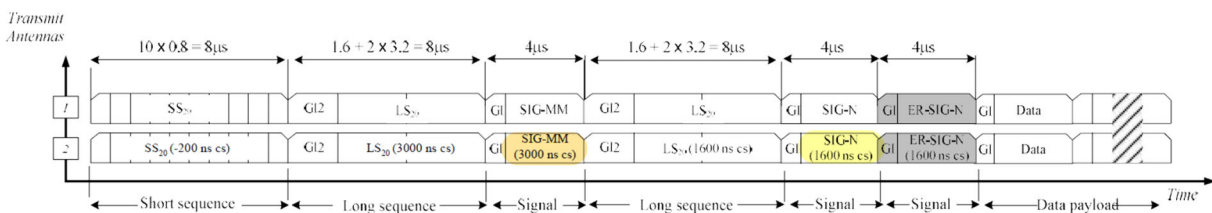


Figure 008 – MIMO-OFDM Training structure for $N_{TX} = 2$, 20 MHz, mixed-mode operation. The shaded field indicates the optional duplicate SIG-N for extended range communication.

And the figure below illustrates a mixed mode normal range (NR)—i.e., non-ER—PPDU for one (40 MHz) or two (20 and 40 MHz) spatial streams.

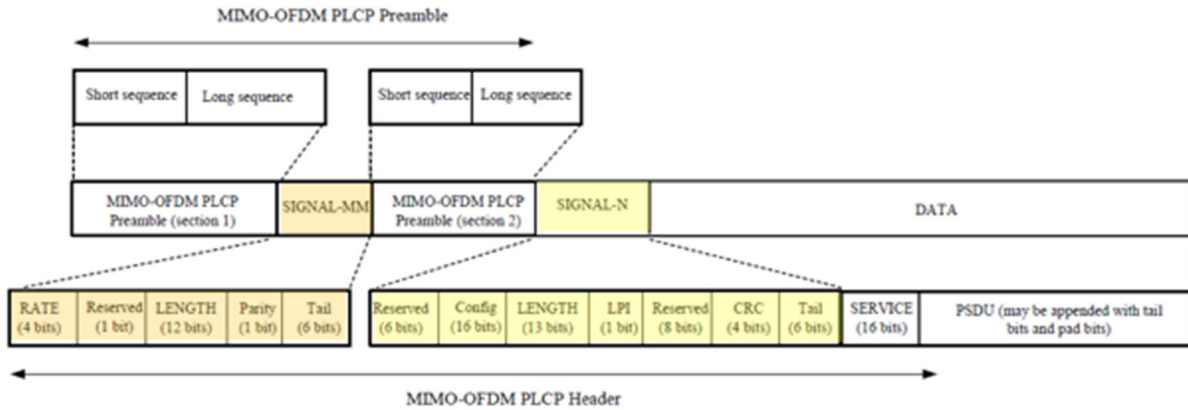


Figure 003 – PPDU frame format: Mixed-mode access in the 1TX (40 MHz) and 2TX (20 and 40 MHz) modes

B. Motivation to Combine

117. A POSITA would have been motivated to combine Hansen and WWiSE to include support for WWiSE’s ER communication in Hansen’s transceiver. For example, a POSITA would have understood the advantages in duplicating header fields for improved diversity and would have been motivated to program Hansen’s processors to generate duplicate (*i.e.*, repeated) header fields such as Signal*-N of Hansen’s Fig. 6a during ER communications, as taught by WWiSE. The duplicated header is referred to herein as “ER-Signal*-N”, consistent with the terminology used by WWiSE.



Hansen’s “Compromise” PPDU with WWiSE’s duplicate SIG-N field for ER communication

118. A POSITA would have been motivated to include support for the fields (or subfields) necessary to support ER in Hansen’s transceiver and would

have had a reasonable expectation of success since programming such fields would have been well within the level of skill of ordinary artisans based on WWiSE's disclosure that is commensurate with other 802.11 wireless standards documents. For example, a POSITA would have been motivated to use one of the reserved bits in Hansen's Signal*-N header field or to extend Hansen's Signal*-N header field to incorporate WWiSE's REXT bit indicating whether a device is operating in NR or ER configuration. A POSITA would have understood that the added bit(s) could be used for the REXT field. (DELL-1006, ¶¶67, 97.) When the REXT field indicates the device is operating in NR mode, the repeated header ER-Signal*-N is not included in the PPDU, and when the REXT field indicates the device is operating in ER mode, the repeated header is included in the PPDU. (DELL-1005, 69–70, Table 011.) A POSITA would have had several reasons to make this proposed combination.

119. **First**, Hansen provides an express teaching that would have led a POSITA to the combination with WWiSE. Hansen describes the earlier January 2005 WWiSE and TGn Sync proposals submitted to the TGn working group. (DELL-1006, ¶33.) Both the January 2005 and March 2005 WWiSE proposals include support for greenfield access. (See, e.g., DELL-1006, ¶¶21-23, 77, 79, 82.) Hansen notes however that TGn Sync did “not provide a mechanism to support greenfield access.” (DELL-1006, ¶33.) Hansen therefore sought to define a

compromise proposal based on the WWiSE and TGN Sync January 2005 proposals. (DELL-1006, Title (“Method and system for compromise greenfield preambles for 802.11n”), ¶7 (“certain embodiments of the invention relate to a method and system for compromise greenfield preambles for 802.11n”); DELL-1010, 14 (“Embodiments of this invention may comprise a plurality of proposals that seek to define a compromise proposal to TGN which is based on aspects of current proposals from WWiSE and TGN sync”); DELL-1006 ¶6 (incorporating Hansen Prov. by reference).) Based on the suggestion to bridge the gap between the WWiSE and TGN Sync industry groups, a POSITA would have been motivated to combine the teachings of WWiSE with Hansen to support the newly introduced aspects of the March WWiSE proposal, including support for WWiSE’s ER features.

120. ***Second***, this combination involves use of a known technique to improve similar devices in the same way. In particular, WWiSE’s ER capability is based on repeating the SIGNAL-N header field (a known technique), which would improve Hansen’s transceiver by providing additional diversity. Diversity is a known technique to improve system performance over fading channels. (DELL-1015, 130.) Fading is generally the variation of received signal power due to changes in transmission medium or paths that occurs from numerous sources including reflections from the ground and surrounding buildings, as well as

scattered signals from trees, people and towers present in the larger area.

(DELL-1022, 944-1011.) Large-scale fading occurs when an obstacle comes in-between the transmitter and receiver. (DELL-1022, 947.) Small-scale fading is concerned with rapid fluctuations of received signal strength over a very short distance and short time period. (DELL-1022, 947.)

121. The three main forms of diversity that are “traditionally exploited in communication systems for fading channels: temporal, spectral, and spatial diversity.” (DELL-1015, 130.) By repeating the header (Signal-N) in the time domain, WWiSE’s ER capability introduces temporal diversity. (See DELL-1005, ¶¶67–69.) Each repeated symbol provides additional diversity, which increases the likelihood of decoding the information correctly at the receiver. This introduction of diversity improves the decodability of the header (Signal-N) in noisy environments or at a greater distance for a given signal power —extending the range of communication and improving the receiver gain. A POSITA therefore would have been motivated to include WWiSE’s ER capability to improve robustness of communication in noisy or otherwise degraded channel conditions.

122. *Third*, this combination is merely the application of a known technique (WWiSE’s ER capability) to a known device (Hansen’s transceiver) that was ready for improvement to yield predictable results. The addition of support for WWiSE’s ER capability to Hansen’s transceiver would extend the range of reliable

communication between devices by providing diversity when environmental conditions (fading and/or noise) adversely affect communication. A POSITA would have applied the known improvement (ER capability of WWiSE) in the same way to Hansen, which already uses a PPDU based on the one disclosed in WWiSE.

123. **Fourth**, this combination is merely a combination of prior art elements according to known methods to yield predictable results (*i.e.*, extended range for devices in a WLAN). For example, as explained above, the combination adds a repeated data field (known method) to the PPDU frame (prior art element) and adds a one-bit sub-field (or reassign existing reserved bit if available) to the header field. A POSITA would have known how to make these modifications because the addition of fields/sub-fields to network packets was commonly done to implement enhanced features or otherwise support modifications to standards such as 802.11. Indeed, reserved bits are provided for this specific purpose. (*See, e.g.*, DELL-1008, 30 (“... define two one-bit fields which are assigned to bits in the PHY frame header that are currently reserved.”).) For example, both Hansen and WWiSE discuss modifications to existing 802.11 PDUs by the addition of fields and sub-fields.

124. The results of this combination would have been predictable, and a POSITA would have had a reasonable expectation of success. Both Hansen and

WWiSE describe PPDU's for use in the 802.11n standard under development. Existing 802.11 standards, which both Hansen and WWiSE build upon, would have been well-known to a POSITA by the earliest priority date of the '146 patent. And as discussed above, the combination adds fields/sub-fields to an existing packet structure. Because such modifications were commonplace when dealing with evolving communications technologies, the results would have been predictable, and a POSITA would have had a reasonable expectation that the combination would operate successfully.

C. Independent Claims 1 and 6³

[1P] A wireless communication device, comprising:

[1A] a wireless receiver configured to receive a wireless packet through a communication channel, formats of the wireless packet including a first packet format and a second packet format, the first packet format comprising a first header field carried by a first orthogonal frequency division multiplexing (OFDM) symbol, the second packet format comprising both the first header field carried by the first OFDM symbol and a second header field carried by a second OFDM symbol which follows the first OFDM symbol, and the second header field being a repetition of the first header field; and

[1B] a demodulator configured to demodulate the received wireless

³ Given the repeated subject-matter among these claims, I have addressed overlapping claims together. To the extent there are any substantive differences between claims or in the corresponding analysis, I have noted that herein. Claim 1 is shown in its entirety as an example.

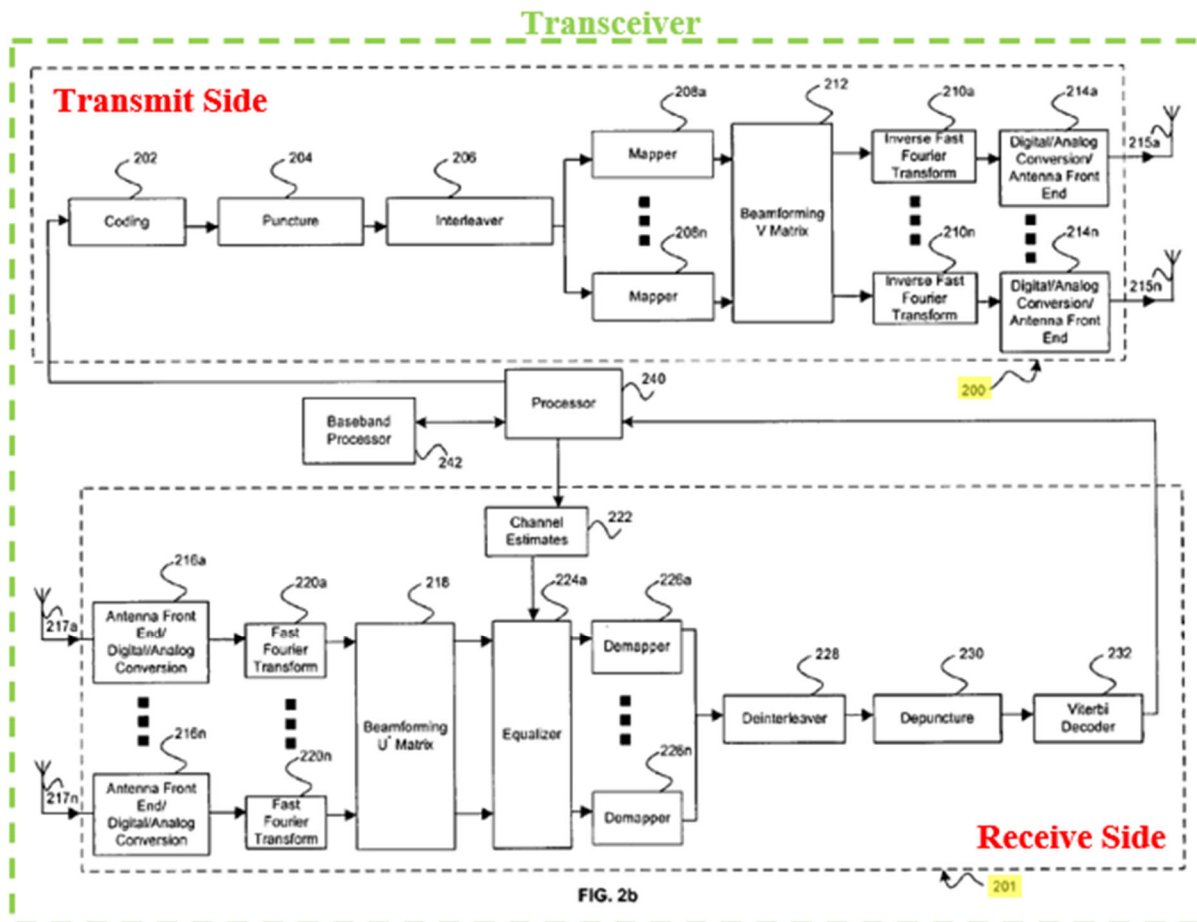
packet,

[1C] wherein the wireless receiver distinguishes the second packet format from the first packet format by detecting, from the received wireless packet, the second header field which repeats the first header field.

125. In my opinion, Hansen in combination with WWiSE renders these claims obvious, as I set forth below.

1. Preamble [1Pre] and [6Pre]

126. The combination of Hansen and WWiSE discloses the preamble. Hansen—which expressly refers to WWiSE (*e.g.*, DELL-1006, ¶¶34, 36, 77, 79)—discloses “a transceiver comprising a transmitter and a receiver in a MIMO system.” (DELL-1006, ¶15, Figure 2b (below); *see also* DELL-1006, ¶57 (structure of Figure 2b is a “wireless communications transceiver”).)



Hansen's transceiver corresponds to "[a] wireless communication device," as recited in the preamble.

2. Claim Limitations [1A] and [6A]

127. In my opinion, the combination of Hansen and WWiSE discloses these limitations.

a. *Wireless receiver configured to receive a wireless packet through a communication channel*

128. Hansen's transceiver includes a receiver for receiving wireless packets through a communication channel. Figure 2b of Hansen (reproduced below) "is an

exemplary block diagram of a transceiver comprising a transmitter and a receiver in a MIMO system.” (DELL-1006, ¶16.) “The receiver 201 may comprise a plurality of antenna front end and analog to digital (A/D) conversion blocks 216 a , ..., 216 n , a beam forming U matrix block 218, a plurality of fast Fourier transform (FFT) blocks 220 a , ..., 220 n , a channel estimates block 222, an equalizer block 224, a plurality of demapper blocks 226 a , ..., 226 n , a deinterleaver block 228, a depuncture block 230, and a Viterbi decoder block 232.” (DELL-1006, ¶41; *see also* DELL-1006, ¶¶50–56 (describing how the components of receiver 201 operate and interact to “*receive* analog RF signals” and ultimately output “decoded data from the Viterbi decoder”).)

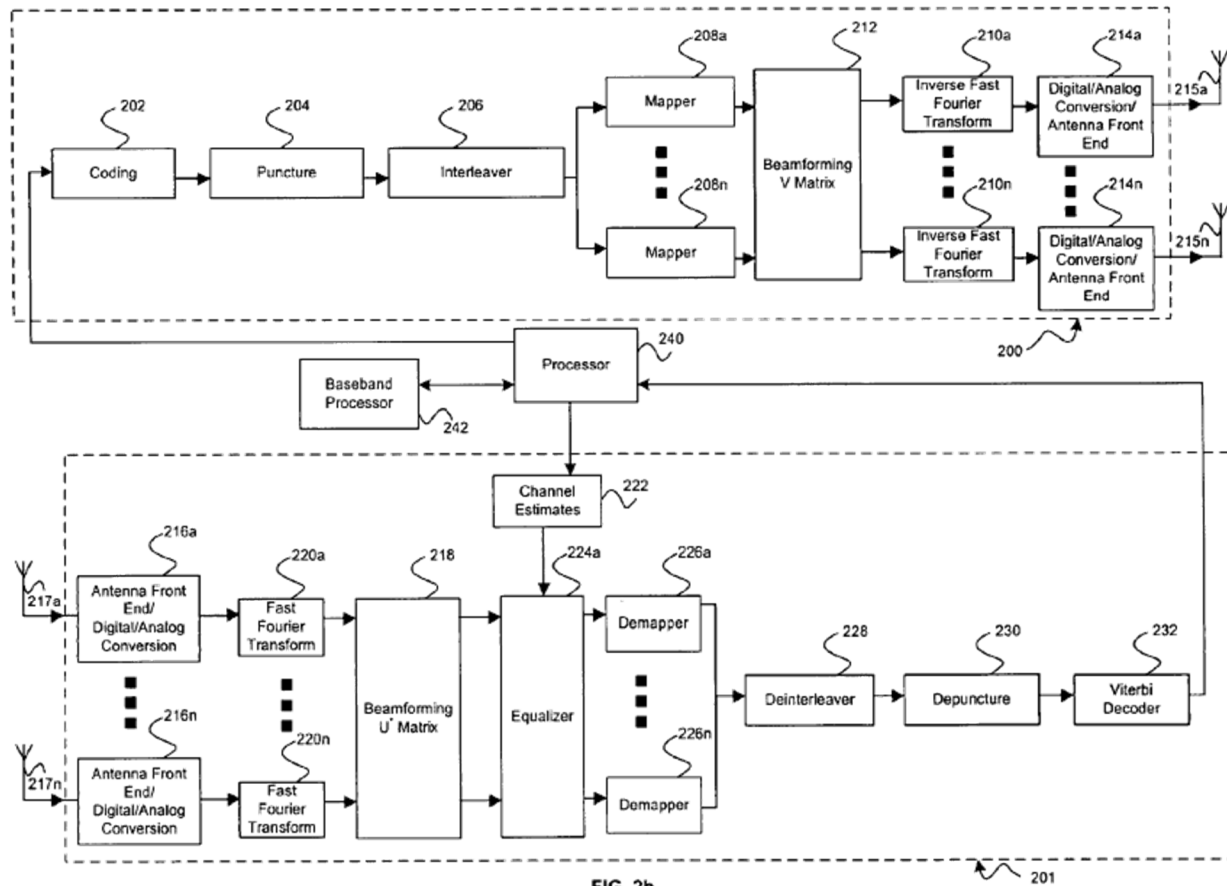


FIG. 2b

A POSITA would have understood that the parallel input pathways in Hansen’s receiver 201—including the “plurality of antenna front end and analog to digital (A/D) conversion blocks 216a, ..., 216n”—operate cooperatively in a MIMO system to receive an incoming wireless transmission, so a POSITA would consider them to be part of a wireless receiver rather than multiple independent wireless receivers.

129. Hansen’s transceiver receives PPDU’s, which are 802.11-compliant packets. (DELL-1006, ¶59; DELL-1013, 7, 13, 33 (referring to “packet” structure and contents).) Hansen’s PPDU is analogous to—and, as discussed above, based

in part on—the 802.11 PPDU in WWiSE (which WWiSE includes in “frames”). (DELL-1005, 59, 67.) Examples of mixed-mode PPDU from WWiSE appear in Figures 003 and 008 below. The first (Figure 003) is for a NM transmission, and the second (Figure 008) is for an ER transmission.

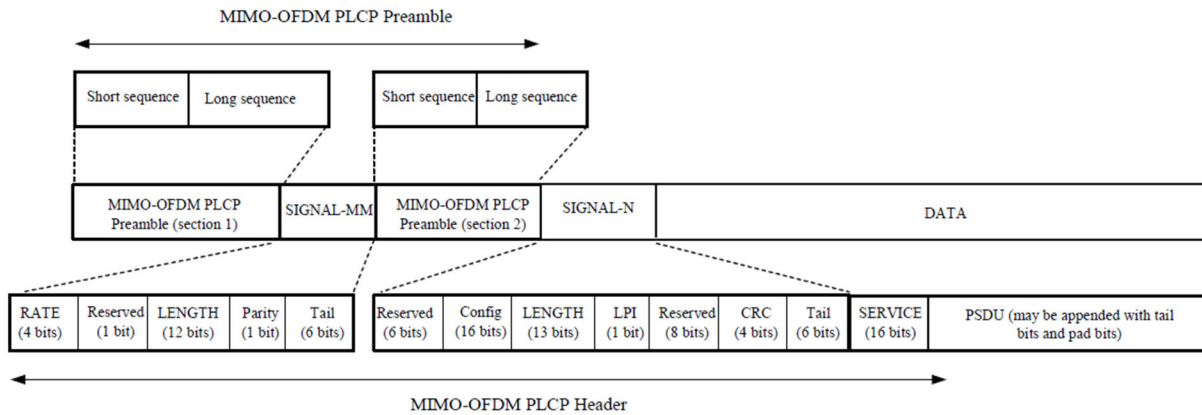


Figure 003 – PPDU frame format: Mixed-mode access in the 1TX (40 MHz) and 2TX (20 and 40 MHz) modes

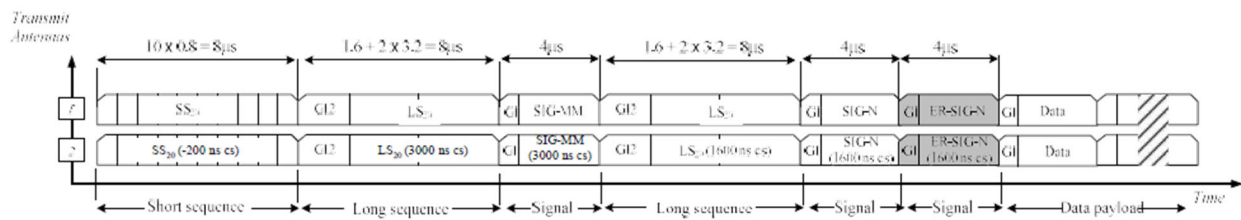


Figure 008 – MIMO-OFDM Training structure for $N_{TX} = 2$, 20 MHz, mixed-mode operation. The shaded field indicates the optional duplicate SIG-N for extended range communication.

130. Hansen’s transceiver is compatible with WWiSE’s mixed-mode PPDU, which can be communicated in a “multiple input multiple output orthogonal frequency division multiplexing (MIMO-OFDM) system” like the one in Hansen’s Figure 2b. (See DELL-1005, 13–14, 30 55; DELL-1006, ¶41.) Hansen’s transceiver also supports communications over the 20MHz and 40MHz

frequency bands. (DELL-1006, ¶¶67–68 (“20 MHz or 40 MHz bandwidth field 494 may indicate whether the PPDU was transmitted utilizing a 20 MHz RF channel, or a 40 MHz RF channel”), 79 (“BW field 560 may represent a bandwidth, for example, 20 MHz, or 40 MHz”). WWiSE refers to these same 20MHz and 40MHz frequency bands as “channels.” (E.g., DELL-1005, 48–49 (“High Throughput PHYs [that] can transmit a frame utilizing a 40 MHz *channel* pair in order to achieve lower frame durations than if a single 20 MHz *channel* was used.”), 84 (40 MHz channel “consists of two 20 MHz *channels*, on each of which there could be 20 MHz transmissions”).) And WWiSE describes “mandatory” transmitting and receiving capabilities over these channels that a POSITA would understand to be performed by a transceiver like Hansen’s. (See DELL-1005, 27 (describing “the bitmap size in bytes between the transmitter and *receiver* STAs with HT Capability”), 55 (explaining that “support for transmitting and *receiving* data using the MIMO-OFDM PHY defined in this Clause is *mandatory*”), 58 (explaining how “PSDUs are converted to and from PPDU’s at the transmitter and *receiver*”), 83 (“The transmitter (*receiver*) shall initiate the modulation constellation, code rate, code type, and other configuration parameters according to the CONFIG indicated in the SIG-N field.”).) A POSITA would therefore have had a reasonable expectation of success in implementing WWiSE’s PPDU’s using Hansen’s transceiver. And to the extent that Hansen’s transceiver

would require modification to be capable of receiving the ER packets of WWiSE (e.g., in Figure 008 above), that modification (e.g., to receive the additional ER-SIG-N header symbol) would have been well within the ability of a POSITA, who would have been motivated to make the modification for the reasons discussed above. (*Supra* § IV.B.)

b. *First packet format with a first header field carried by a first OFDM symbol*

131. Hansen’s 802.11-compliant transceiver “implement[s] orthogonal frequency division multiplexing (OFDM).” (See DELL-1006, ¶¶48, 51.) And WWiSE similarly describes “the PHY entity for a multiple input multiple output orthogonal frequency division (MIMO-OFDM) system” (DELL-1005, 55.) As discussed above (*supra* §IV.C.2.a), Hansen’s OFDM transceiver would receive WWiSE’s mixed-mode PPDU in both the ER and NR configurations. And WWiSE explains that devices operating in NR configuration communicate using a PPDU (*i.e.*, a packet) that includes “MIMO-OFDM PLCP preamble, MIMO-OFDM PLCP header, PSDU, and may consist of appended tail bits and pad bits.” (DELL-1005, 58.) “The MIMO-OFDM PLCP header is composed of the SIGNAL-N field and the SERVICE field,” where “[t]he SIGNAL-N field ... consists of 54 bits that specify all configuration and length-related parameters associated with PPDU transmission,” including “bandwidth, modulation, code rate, code type, number of TX antennas, and number of spatial streams.” (DELL-1005,

58, 83.) WWiSE further explains that “[i]n the mandatory standard configuration, SIG-N is composed of a single MIMO-OFDM *symbol*” (DELL-1005, 69.)

Figure 003 of WWiSE presents an example of a NR packet for a device in mixed mode.

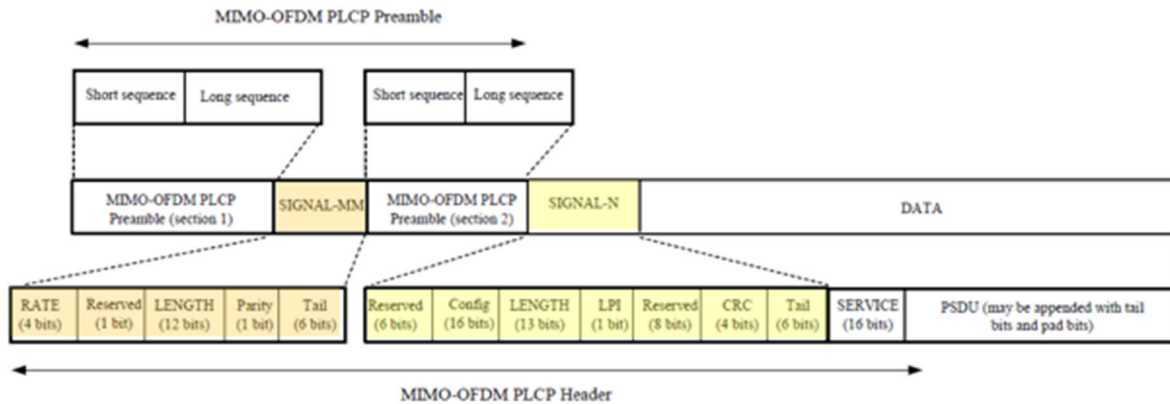


Figure 003 – PPDU frame format: Mixed-mode access in the 1TX (40 MHz) and 2TX (20 and 40 MHz) modes

c. *Second packet format with the first header field and a second header field that repeats the first header field*

132. When operating in ER mode, devices communicate using “the long SIG-N field format”—which, according to WWiSE, means “[t]he SIG-N MIMO-OFDM symbol, followed by a second MIMO-OFDM symbol, denoted as ER-SIG-N.” (DELL-1005, 50, 69.) An example is shown in Figure 008 for a device in “mixed mode operation.” (DELL-1005, 67.)

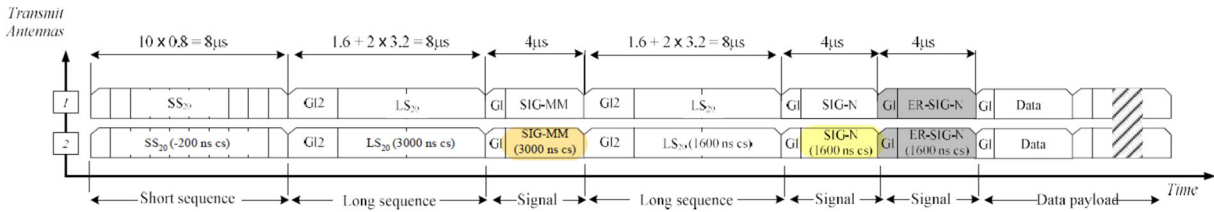


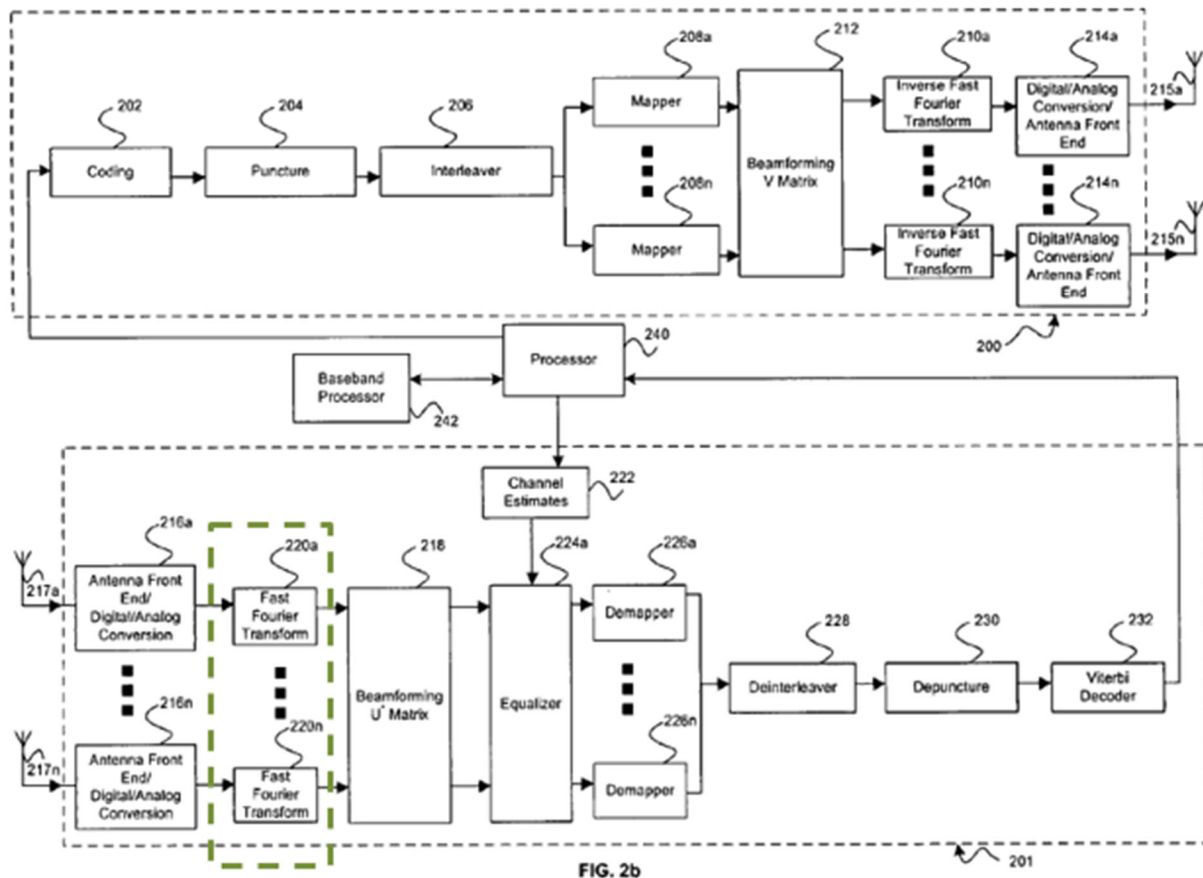
Figure 008 – MIMO-OFDM Training structure for $N_{TX} = 2$, 20 MHz, mixed-mode operation. The shaded field indicates the optional duplicate SIG-N for extended range communication.

The figure caption explains that ER-SIG-N (shaded gray) is an “optional duplicate [of] SIG-N for extended range communication.”

133. NR mode thus uses a “*first packet format*” with a SIG-N symbol in the header (“*a first header field carried by a first OFDM symbol*”), whereas ER mode uses a “*second packet format*” with a SIG-N header symbol (“*the first header field carried by the first OFDM symbol*”) followed by a ER-SIG-N header symbol (“*a second header field carried by a second OFDM symbol which follows the first OFDM symbol*”) that repeats the bits of SIG-N (“*the second header field being a repetition of the first header field*”).

3. Claim Limitations [1B] and [6B]

134. In my opinion, the combination of Hansen and WWiSE discloses these limitations. The demodulator, for example, is illustrated in Figure 2b of Hansen shown below.



As shown, “[e]ach [Fast Fourier Transform] FFT block 220a, ..., 220n may *receive* a signal from an antenna front end and A to D conversion block 216a, ..., 216n, independently applying a n-point FFT technique, *demodulating* the signal by a plurality of carrier signals” for the purpose of “extract[ing] n signals contained in each of the plurality of OFDM signals received by the receiver 201.”

(DELL-1006, ¶51.) Hansen’s FFT (the “*demodulator*,” in the green box above) thus receives incoming packets from the front end and Digital/Analog converter (the “*receiver*,” in the orange box). A POSITA would have understood the collection of FFTs to constitute a demodulator.

135. Moreover, a demodulator would have been needed to demodulate WWiSE's packets before they could be decoded and processed. For example, a received OFDM symbol carrying the SIGNAL field in WWiSE (like the one in Figure 008) must be demodulated before recovering the bits that set receiver configuration parameters. (DELL-1005, 92.) A POSITA would therefore have had a reasonable expectation of success in using Hansen's demodulator to demodulate WWiSE's packets because they are compatible with the same versions of 802.11, because Hansen expressly refers to packet structures in WWiSE, and because WWiSE uses header symbols (*e.g.*, SIG-N or Signal-N) analogous to those in Hansen's PPDU's. (DELL-1005, 69; DELL-1006, ¶¶77, 79, Fig. 5a & 5b; *see also supra* §IV.C.2.b.)

136. Notably, however, Hansen describes the demodulator (*i.e.*, FFT block 220a, ..., 220n) as being part of "receiver 201"—which includes the entire chain of components in the receive path—instead of describing the demodulator and receiver as separate components. (DELL-1006, ¶¶50–51, Fig. 2b.) This contrasts with the '146 patent disclosure that describes and claims the receiver and demodulator as separate components. The claimed "*receiver*" of the '146 patent would thus correspond to Hansen's Antenna Front End/Digital/Analog Conversion blocks (216a, ..., 216n), and the claimed "*demodulator*" of the '146 patent would correspond to Hansen's FFT blocks (220a, ..., 220n). I therefore disagrees that

including the demodulator within the receiver is consistent with the plain and ordinary meaning of the claim language, but Hansen’s description is nevertheless consistent with PO’s apparent interpretation and application of the claims in the co-pending district court case. In particular, PO’s Preliminary Infringement Contentions point to the same PHY-layer disclosures from the 802.11ax standard to satisfy both the “receiver” ([1A]/[6A]) and “demodulator” ([1B]/[6B]) limitations of claims 1 and 6 (*compare* DELL-1039, App. E, 7–9 (relying upon, among other things, excerpts from §§17.3, 19.3, 21.3, 27.3 as evidence of the claimed “receiver”) *with* DELL-1039, App. E, 31–32 (relying on excerpts from §§17.3, 19.3, 21.3, and 27.3 as evidence of the claimed “demodulator”))), indicating that, under PO’s infringement theory, the accused demodulator can be part of the accused receiver. Therefore, under PO’s broad apparent interpretation of the claim, the claimed “demodulator” is disclosed in Hansen.

4. Claim Limitations [1C] and [6C]

137. In my opinion, the combination of Hansen and WWiSE discloses these limitations.

138. As I have discussed above, WWiSE discloses NR wireless packets as well as ER packets for improved reliability when, for example, an STA operates far away from an AP. (*See supra* §IV.C.2.c.) Both packet formats include a SIG-N header symbol—as illustrated, for example, in Figures 003 (NR mixed-mode

packet) and 008 (ER mixed-mode packet) below—that “specif[ies] all configuration and length-related parameters associated with PPDU transmission.” (WWiSE, 50, 58, 69, 83.)

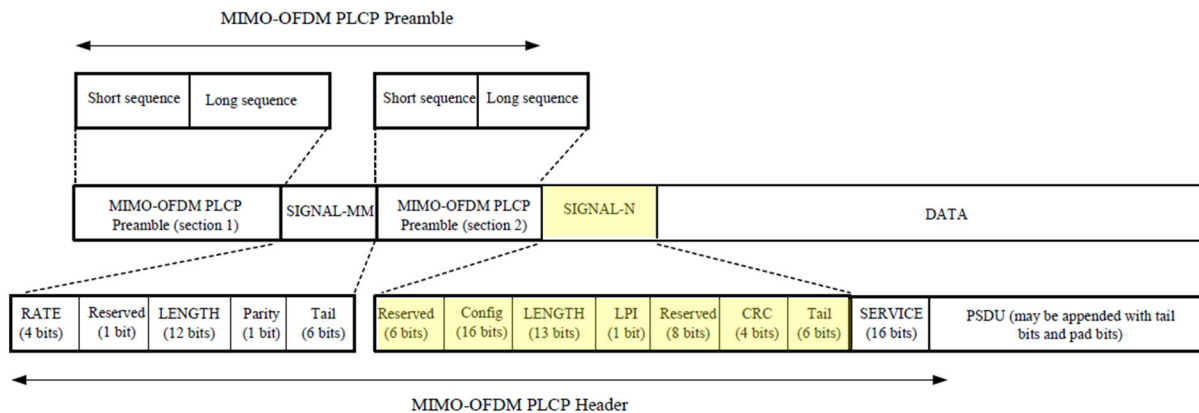


Figure 003 – PPDU frame format: Mixed-mode access in the 1TX (40 MHz) and 2TX (20 and 40 MHz) modes

In addition, the ER packet includes an ER-SIG-N header symbol that repeats the SIG-N header symbol. (See *supra* § IV.C.2.c.) Accordingly, a wireless receiver in an AP or STA in WWiSE’s system distinguishes the ER packet format (“*second packet format*”) from the NR packet format (“*first packet format*”) by detecting the ER-SIG-N header symbol (“*detecting, from the received wireless packet, the second header field which repeats the first header field*”).

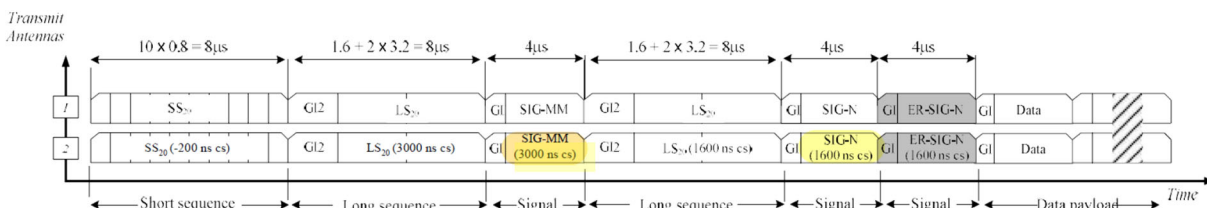


Figure 008 – MIMO-OFDM Training structure for $N_{TX} = 2$, 20 MHz, mixed-mode operation. The shaded field indicates the optional duplicate SIG-N for extended range communication.

139. WWiSE further discloses the specific “bit assignment” for the SIG-N field, including a REXT bit that indicates whether “[s]tandard or extended communication range configuration”—*i.e.*, NR or ER—is used. (DELL-1005, 50, 69.) An ER packet “shall be transmitted with ... the REXT bit set to value 1” in the SIG-N field, whereas in a NR packet, the REXT bit is set to zero, as shown in Table 011 below. (DELL-1005, 50, 69, Table 011.)

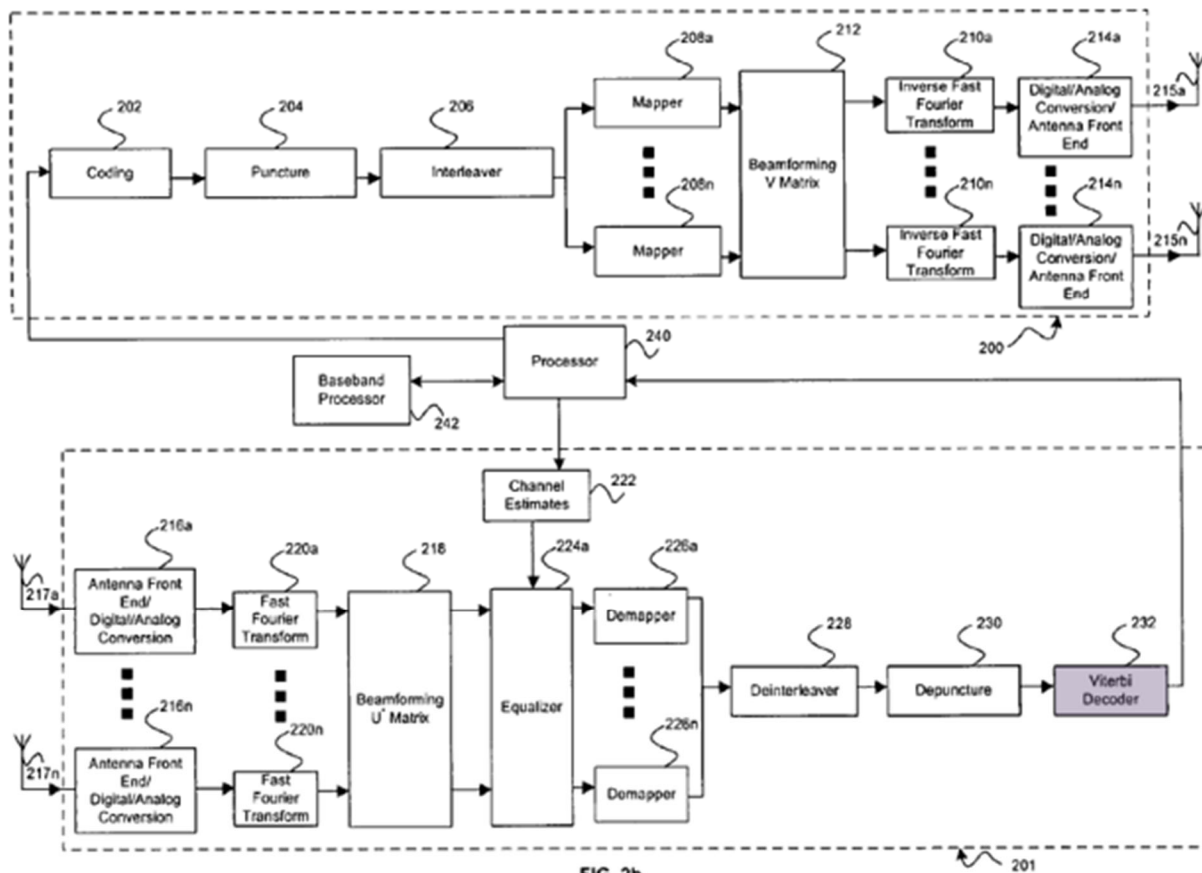
Table 011—SIG-N field bit assignment

Bits	Field	Subfield	Parameter	Values
B0 : b5	RSVD		Reserved bits	111111, Bits shall be ignored at the receiver
B6 : b21	CONFIG		Configuration	
B6 : b8		NSS	Number of spatial streams	000: 1, 001: 2, 010: 3, 011: 4
B9 : b11		NTX	Number of transmit antennas	000: 1, 001: 2, 010: 3, 011: 4
B12 : b13		BW	Bandwidth	00: 20 MHz, 01: 40 MHz
B14: b16		R	Code rate	000: 1/2, 001: 2/3, 010: 3/4, 011: 5/6
B17 : b18		CT	ECC type	00 : convolutional, 01 : LDPC
B19 : b21		CON	Constellation type	000: BPSK, 001: QPSK, 010: 16-QAM, 011: 64-QAM
B22 : b34	LEN		Length	Number of bytes in the payload. The value of 0 is allowed.
b35	LPI		Last PSDU indicator	1 indicates that this is the last PSDU to be aggregated into the current PPDU. LPI shall have the value of 1 when the value of the LEN field is 0.
b36	REXT		Standard or extended communication range configuration	0 indicates the standard configuration, 1 indicates the extended communication range configuration
b37 : b43	RSVD		Reserved	0000000, bits shall be ignored at the receiver
b44 : b47	CRC		Cyclic Redundancy Check	CRC calculated on bits 0-43 using generator polynomial x^4+x+1
b48 : b53	TAIL			000000

This is analogous to the ’146 patent disclosure of communicating “the value of D in the header so that all nodes know how many OFDM symbols are carrying header information.” (DELL-1001, 2:51–3:1.) And to ascertain the number of header symbols, a receiver in the ’146 patent “starts processing the header by

decoding one OFDM header symbol,” and if successful, “then the receiver knows how many more OFDM symbols (D-1) are carrying header information for a given frame.” (DELL-1001, 3:1–5.) Similarly, a wireless receiver in an AP or STA in WWiSE’s system distinguishes between an NR packet (“*first packet format*”) and an ER packet (“*second packet format*”) based on the SIG-N field—including the REXT bit—which indicates the presence or absence of the ER-SIG-N field (“*detecting, from the received wireless packet, the second header field which repeats the first header field*”).

140. In the combined system of Hansen and WWiSE, the decoding of SIG-N and/or ER-SIG-N header symbols to detect the value of the REXT bit occurs in the Viterbi Decoder 232 (shaded purple) in Fig. 2b below.



But as discussed in §III.C.3 above, Hansen describes “receiver 201” as including the entire chain of components in the receive path, including the FFT block 220a, ..., 220n (the “demodulator”) and Viterbi Decoder 232. (DELL-1006, ¶¶50, 55–56, Fig. 2b.) This contrasts with the ’146 patent disclosure that, for example, describes and claims (e.g., in claim 1) the receiver and demodulator as separate components.⁴ (See *supra* §III.C.3.) Petitioner therefore does not agree that including the demodulator and decoder within the receiver satisfies claim 1 of the

⁴ Challenged method claim 6 does not recite “a receiver” or “a demodulator.”

patent, but Hansen’s description is nevertheless consistent with PO’s apparent interpretation and application of the claim in the co-pending district court case, where PO’s Preliminary Infringement Contentions point to the same PHY-layer disclosures from the 802.11ax standard to satisfy both the “receiver” ([1A]/[1C]) and “demodulator” ([1B]) limitations of claim 1 (compare DELL-1039, App. E, 7–9 (relying upon, among other things, excerpts from §§17.3, 19.3, 21.3, 27.3 as evidence of the claimed “receiver”) and 33–36 (not identifying any additional structure for “distinguishing”) with DELL-1039, App. E, 31–32 (relying on excerpts from §§17.3, 19.3, 21.3, and 27.3 as evidence of the claimed “demodulator”))). This indicates that, under PO’s infringement theory, the accused receiver can encompass other components in the receive pathway, including the demodulator and decoder. Therefore, under PO’s broad apparent interpretation of the claim, the combination of Hansen and WWiSE discloses this limitation of claim 1.

D. Claims 2 and 7

[2] The wireless communication device of claim 1, wherein the wireless receiver determines the received wireless packet as the second packet format when the second header field is detected from the wireless packet.

141. The combination of Hansen and WWiSE discloses a WLAN device (*e.g.*, an AP or STA) with a receiver that receives both NR (“*the first packet format*”) and ER (“*the second packet format*”) packets like the ones in Figures 003

and 008, respectively, below. (*See supra* §IV.C.2.)

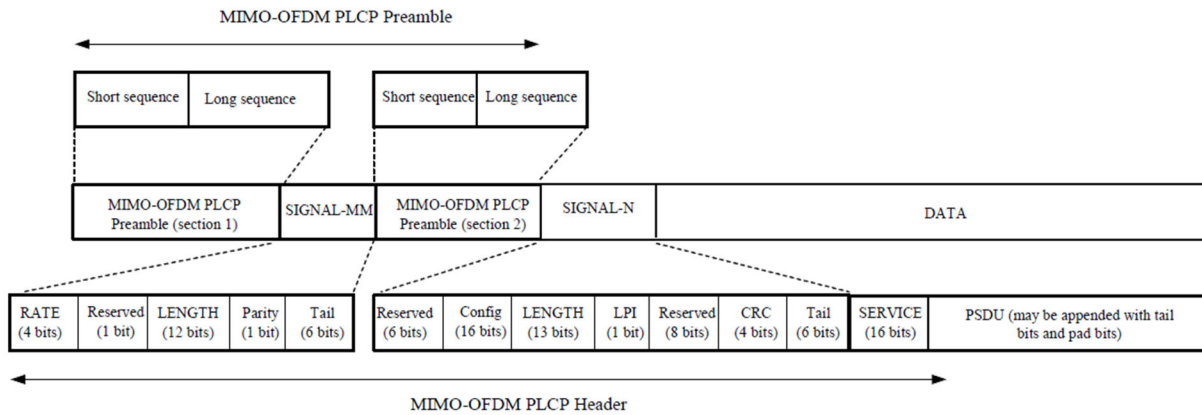


Figure 003 – PPDU frame format: Mixed-mode access in the 1TX (40 MHz) and 2TX (20 and 40 MHz) modes

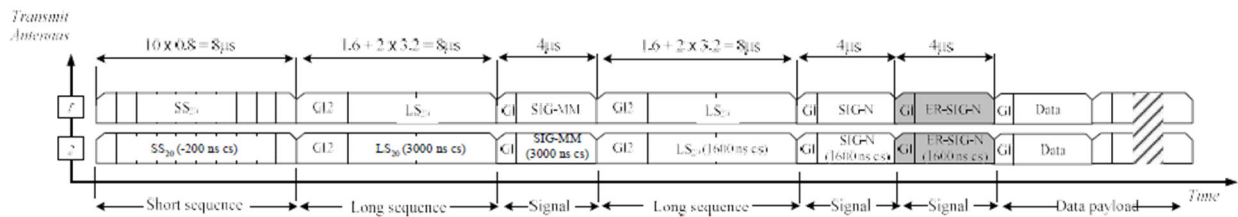


Figure 008 – MIMO-OFDM Training structure for $N_{TX} = 2$, 20 MHz, mixed-mode operation. The shaded field indicates the optional duplicate SIG-N for extended range communication.

(DELL-1005, 50, 67.) As shown, an ER packet (“*the second packet format*”)

includes SIG-N and ER-SIG-N header symbols, where ER-SIG-N (“*the second*

header field”) repeats the bits of SIG-N. (*See supra* §IV.C.2.c.) Included among

those bits is REXT, which, as discussed above, is set to a value of “1” to indicate

an ER configuration or a value of “0” to indicate a NR configuration. (*See supra*

§IV.C.4; DELL-1005, 50, 69, Table 011.)

Table 011—SIG-N field bit assignment

Bits	Field	Subfield	Parameter	Values
B0 : b5	RSVD		Reserved bits	111111, Bits shall be ignored at the receiver
B6 : b21	CONFIG		Configuration	
B6 : b8		NSS	Number of spatial streams	000: 1, 001: 2, 010: 3, 011: 4
B9 : b11		NTX	Number of transmit antennas	000: 1, 001: 2, 010: 3, 011: 4
B12 : b13		BW	Bandwidth	00: 20 MHz, 01: 40 MHz
B14: b16		R	Code rate	000: 1/2, 001: 2/3, 010: 3/4, 011: 5/6
B17 : b18		CT	ECC type	00 : convolutional, 01 : LDPC
B19 : b21		CON	Constellation type	000: BPSK, 001: QPSK, 010: 16-QAM, 011: 64-QAM
B22 : b34	LEN		Length	Number of bytes in the payload. The value of 0 is allowed.
b35	LPI		Last PSDU indicator	1 indicates that this is the last PSDU to be aggregated into the current PPDU. LPI shall have the value of 1 when the value of the LEN field is 0.
b36	REXT		Standard or extended communication range configuration	0 indicates the standard configuration, 1 indicates the extended communication range configuration
b37 : b43	RSVD		Reserved	0000000, bits shall be ignored at the receiver
b44 : b47	CRC		Cyclic Redundancy Check	CRC calculated on bits 0-43 using generator polynomial x^4+x+1
b48 : b53	TAIL			000000

Detecting a value of “1” for the REXT bit indicates to the receiver that an incoming packet is in the ER format. Furthermore, if the receiver is unable to decode the SIG-N field in an ER packet—and therefore does not detect the value of REXT from the “first header field”—it would have been obvious to a POSITA that the receiver would decode the ER-SIG-N field of that same packet to detect the value of REXT from the “second header field.” As discussed in section §VI.B. above, repeating a header symbol (e.g., duplicating the contents of SIG-N in ER-SIG-N) increases diversity by increasing the likelihood that a given symbol is reliably received and decoded; so if, for example, a deep fade wipes out the first symbol, the header information will nevertheless be recovered from the repeated

copy in the second symbol. (DELL-1024, 60-61, Fig. 3.5.) A POSITA reading WWiSE would have understood this to be reason for duplicating the SIG-N symbol in an ER packet. This corresponds to “*determin[ing] the received wireless packet as the second packet format when the second header field is detected from the wireless packet*” and is consistent with the ’146 patent disclosure, where the value of D—like REXT—is contained “in the header so that all nodes know how many OFDM symbols are carrying header information” (DELL-1001, 2:51–3:1), and a receiver “starts processing the header by decoding one OFDM header symbol” such that, if successful, “the receiver knows how many more OFDM symbols (D-1) are carrying header information for a given frame,” or if unsuccessful “(i.e., the header decoding fails), then the receiver can try to decode two OFDM header symbols, and so on.” (DELL-1001, 3:1–8.)

E. Claims 3 and 8

[3] The wireless communication device of claim 1, wherein the wireless receiver determines the received wireless packet as the first packet format when the second header field is not detected from the wireless packet.

142. As I have discussed above, the combination of Hansen and WWiSE teaches a WLAN device (*e.g.*, an AP or STA) with a receiver that receives both NR (“*the first packet format*”) and ER (“*the second packet format*”) packets, where both packet types include a SIG-N header symbol, and an ER packet additionally includes an ER-SIG-N header symbol (“*the second header field*”). (*See supra*

§IV.C.2.) As further explained above, the REXT bit in the SIG-N header field indicates the format—NR or ER—of the transmitted packet, where a value of “0” informs the receiver that an incoming packet is in the NR format and therefore will *not* include an ER-SIG-N header symbol. (See *supra* §IV.C.4.) So after decoding a SIG-N symbol with a REXT bit value of “0,” the receiver will not detect an ER-SIG-N symbol (“*the second header field*”) and will determine that the incoming packet is in the NR format (“*the first packet format*”). This corresponds to the claimed “*determin[ing] the received wireless packet as the first packet format when the second header field is not detected from the wireless packet*” and is consistent with the ’146 patent disclosure as discussed above. (See *supra* §IV.C.4.)

F. Claims 4 and 9

[4] The wireless communication device of claim 1, wherein the first and second header fields contain information for decoding the wireless packet.

143. As I have discussed above, the ER packet format of WWiSE includes a header with SIG-N and ER-SIG-N header fields (“*the first header field*” and “*second header field*,” respectively), as illustrated in Figure 008 below. (See *supra* §IV.C.2.c.)

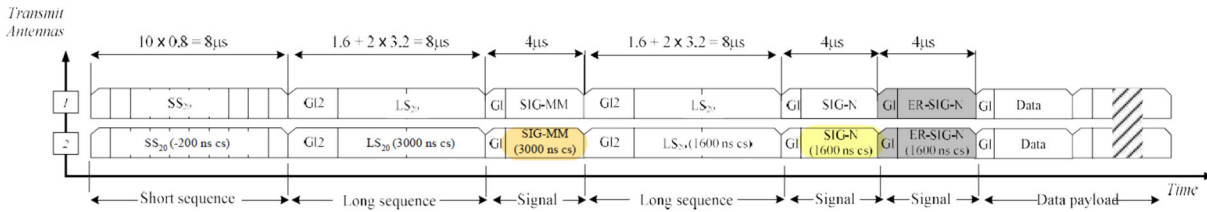


Figure 008 – MIMO-OFDM Training structure for $N_{TX} = 2$, 20 MHz, mixed-mode operation. The shaded field indicates the optional duplicate SIG-N for extended range communication.

The ER-SIG-N field repeats the contents of the SIG-N field, and WWiSE explains that “[t]he SIGNAL-N field”—and therefore also the ER-SIG-N field—“consists of 54 bits that specify all configuration and length-related parameters associated with PPDU transmission,” including “bandwidth, modulation, code rate, code type, number of TX antennas, and number of spatial streams.” (DELL-1005, 58, 69, 83.) A POSITA would understand this information (*e.g.*, code rate and code type) is required “for decoding the wireless packet” at the receiver.

G. Claims 5 and 10

[8] The wireless communication device of claim 1, wherein the first and second header fields contain information related to a length of the wireless packet.

144. As I have discussed above, the ER packet format of WWiSE includes a header with SIG-N and ER-SIG-N header fields (“*the first header field*” and “*second header field*,” respectively), as illustrated in Figure 008 below. (*See supra* §IV.C.2.c.)

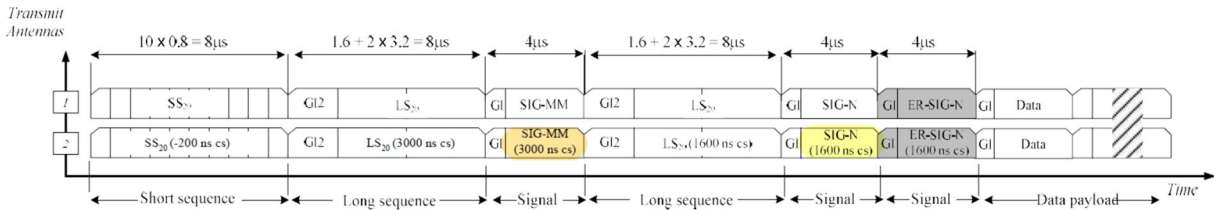


Figure 008 – MIMO-OFDM Training structure for $N_{TX} = 2$, 20 MHz, mixed-mode operation. The shaded field indicates the optional duplicate SIG-N for extended range communication.

The ER-SIG-N field repeats the contents of the SIG-N field, and WWiSE explains that “[t]he SIGNAL-N field”—and therefore also the ER-SIG-N field—“consists of 54 bits that specify all configuration and *length-related parameters* associated with PPDU transmission,” including “bandwidth, modulation, code rate, code type, number of TX antennas, and number of spatial streams.” (DELL-1005, 58, 69, 83.) Additionally, Figure 003 of WWiSE illustrates the “*LENGTH*” field in the SIG-N header symbol (shaded yellow below), which Table 011 (also below) describes as providing the “[n]umber of bytes in the payload.”

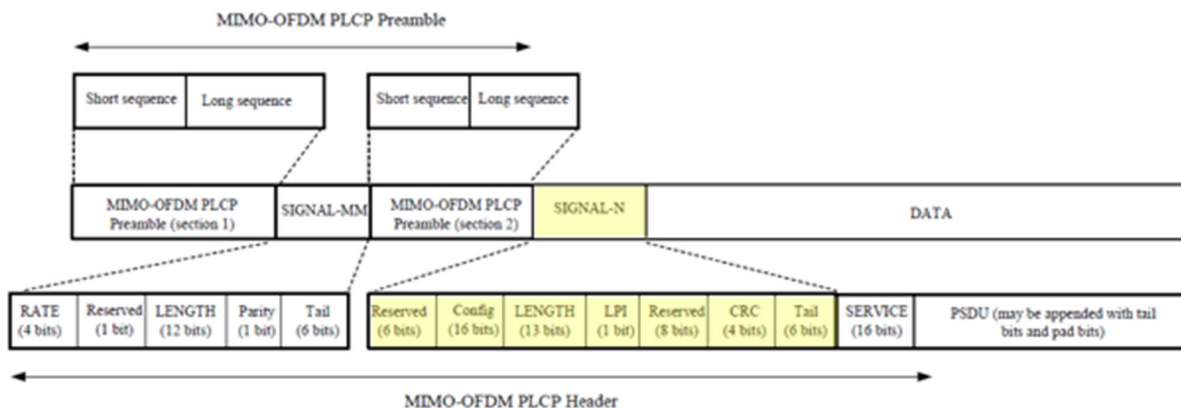


Figure 003 – PPDU frame format: Mixed-mode access in the 1TX (40 MHz) and 2TX (20 and 40 MHz) modes

(DELL-1005, 59.)

Table 011—SIG-N field bit assignment

Bits	Field	Subfield	Parameter	Values
B0 : b5	RSVD		Reserved bits	111111, Bits shall be ignored at the receiver
B6 : b21	CONFIG		Configuration	
B6 : b8		NSS	Number of spatial streams	000: 1, 001: 2, 010: 3, 011: 4
B9 : b11		NTX	Number of transmit antennas	000: 1, 001: 2, 010: 3, 011: 4
B12 : b13		BW	Bandwidth	00: 20 MHz, 01: 40 MHz
B14: b16		R	Code rate	000: 1/2, 001: 2/3, 010: 3/4, 011: 5/6
B17 : b18		CT	ECC type	00 : convolutional, 01 : LDPC
B19 : b21		CON	Constellation type	000: BPSK, 001: QPSK, 010: 16-QAM, 011: 64-QAM
B22 : b34	LEN		Length	Number of bytes in the payload. The value of 0 is allowed.
b35	LPI		Last PSDU indicator	1 indicates that this is the last PSDU to be aggregated into the current PPDU. LPI shall have the value of 1 when the value of the LEN field is 0.
b36	REXT		Standard or extended communication range configuration	0 indicates the standard configuration, 1 indicates the extended communication range configuration
b37 : b43	RSVD		Reserved	0000000, bits shall be ignored at the receiver
b44 : b47	CRC		Cyclic Redundancy Check	CRC calculated on bits 0-43 using generator polynomial x^4+x+1
b48 : b53	TAIL			000000

(DELL-1005, 70). SIG-N thus provides “*information related to a length of the wireless packet.*”

V. Conclusion

In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-

examination.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed this 19th day of March in Greenfield Township, PA.

Respectfully submitted,



Tom La Porta, Ph.D.

ATTACHMENT A

Exhibit	Reference
1001	U.S. Patent No. 11,212,146 (“the ’146 patent”)
1002	File History of the ’146 patent
1003	Declaration of Dr. Tom La Porta in Support of Petition
1004	Curriculum Vitae of Dr. Tom La Porta
1005	IEEE 802.11-05/0149r5, <i>WWiSE Proposal: High Throughput Extension to the 802.11 Standard</i> to Kose, et al, uploaded and publicly available on July 9, 2005 (“WWiSE”)
1006	U.S. Patent Publication No. 2006/0182017 to Hansen et al. (“Hansen”)
1007	Declaration of James L. Lansford, Ph.D.
1008	U.S. Provisional Application 61/235,909 (“the ’909PROV”)
1009	U.S. Patent 8,737,189 to Hansen, et al (“Hansen Patent”)
1010	U.S. Provisional Application 60/653,429 (“Hansen Provisional”)
1011	IEEE 802.11-04/0889r3, <i>TGn Sync Proposal Technical Specification</i> , to Mujtaba, uploaded and publicly available on January 20, 2005 (“TGn Sync”)
1012	IEEE 802.11-04/0886r6, <i>WWiSE Proposal: High Throughput Extension to the 802.11 Standard</i> , to Hansen, et al, uploaded and publicly available on January 6, 2005 (“January 2005 WWiSE”)
1013	IEEE Std. 802.11a-1999, <i>Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: High-Speed Physical Layer in the 5 GHz Band</i> , approved September 16, 1999 (“802.11a”)
1014	Declaration of David Ringle for 802.11a-1999 - IEEE Standard for Telecommunications and Information Exchange Between Systems – LAN/MAN Specific Requirements - Part 11: Wireless Medium Access Control (MAC) and physical layer (PHY) specifications: High-Speed Physical Layer in the 5 GHz Band, date of publication December 30, 1999

Exhibit	Reference
1015	J. Heiskala, et al., <i>OFDM Wireless LANs: A Theoretical and Practical Guide</i> (Sams Publishing 2002) (“Heiskala”)
1016	D. Tse, et al., <i>Fundamentals of Wireless Communication</i> (Cambridge University 2005) (“Tse”)
1017	U.S. Publication No. 2007/0115802 to Yu et al. (“Yu”)
1018	E. Perahia, “IEEE 802.11n Development: History, Process, and Technology,” IEEE Communications Magazine, July 2008
1019	U.S. Provisional Application 61/229,900 (“the ’900PROV”)
1020	<i>IEEE 100: The Authoritative Dictionary of IEEE Standard Terms</i> (IEEE 7th ed., 2000)
1021	R. Van Nee, et al., <i>OFDM for Wireless Multimedia Communications</i> , Artech House Publishers (2000) (“Van Nee”)
1022	B. Sklar, <i>Digital Communications: Fundamentals and Applications</i> (2d ed. 2001) (“Sklar”)
1023	M. Gast, <i>802.11 Wireless Networks: The Definitive Guide</i> (O’Reilly, 2002) (“Gast”)
1024	Aware, <i>G.hn: PHY-Frame Header Extension</i> , 09CC-046, Concord, CA, as filed in file wrapper of the ’566 patent
1025	CopperGate Communication, <i>G.hn: Using Two Symbols for the Header of a PHY frame on Coax</i> , ITU-T SG15/Q4, 09XC-100, Xian, China July 2009, as filed in file wrapper of the ’566 patent
1026	Intellon Corporation, <i>G.hn: Extended PHY frame header</i> , ITU-T SG15/Q4, 09XC-119, Xian, China, July 2009, as filed in file wrapper of the ’566 patent
1027	B. O’Hara et al., <i>802.11 Handbook: A Designer’s Companion</i> (IEEE 1999) (“O’Hara”)
1028	Editor for G.9960, <i>ITU-T Recommendation G.9960 Next Generation Wire-line Based Home Networking Transceivers-Foundation</i> , ITU-T SG15/Q4, January 2009, as filed in file wrapper of the ’566 patent

Exhibit	Reference
1029	IEEE 802.11-04/422r4, <i>New Participant Orientation</i> , presentation submission (July 2004) (Appendix A to Lansford Declaration, IEEE 802wirelessworld website, “New Participant Orientation” slides, available at https://mentor.ieee.org/802.11/dcn/04/11-04-0422-04-0000-new-participantorientation.ppt (Appendix A to DELL-1007)
1030	IEEE 802.11-04/736r1, <i>Approved Minutes of the IEEE P802.11 Full Working Group</i> , Minutes (July 2004) (Appendix B to Lansford Declaration, DELL-1007) IEEE 802wirelessworld website, July 2004 Meeting Minutes, available at http://grouper.ieee.org/groups/802/11/Minutes/Cons_Minutes_July-2004.pdf (Appendix B to DELL-1007).
1031	U.S. Patent 7,415,074 (Appendix C to DELL-1007)
1032	A. Stephens, <i>802.11 “Decrypted”</i> , ACM SIGCOMM Computer Communication Review, Vol. 35, No. 2 (April 2005) (“Stephens Paper”) (Appendix D to Lansford Declaration, DELL-1007).
1033	J. Lörincz, et al, <i>Physical Layer Analysis of Emerging IEEE 802.11n WLAN Standard</i> , 8th International Conference Advanced Communication Technology (February 20-22, 2006); added to IEEE Xplore May 8, 2006
1034	J. Cox, <i>Stage Set for Compromise on IEEE High-Speed Wireless</i> , Network World (March 21, 2005)
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Exhibit	Reference
1039	Infringement Contents with Appendices served in <i>AX Wireless LLC v. Dell Inc. et al.</i> , and <i>AX Wireless LLC v. HP Inc.</i> , U.S. District Court Eastern District of Texas, Case Numbers 2:22-cv-00277 and 2:22-cv-00279, November 3, 2022
1040	Jan. 11, 2024 Letter from Sarah Piepmeier to Kevin Wheeler regarding Dell Stipulation
1041	Sixth Amended Docket Control Order, <i>AX Wireless LLC v. Dell Inc. et al.</i> , No. 2:22-cv-00277-RWS-RSP (E.D. Tex. Feb. 26, 2024), ECF No. 171
1042	Third Amended Docket Control Order, <i>AX Wireless LLC v. Lenovo Grp. Ltd.</i> , No. 2:22-cv-00280-RWS-RSP (E.D. Tex. Oct. 31, 2023), ECF No. 130
1043	Docket Control Order, <i>LightGuide, Inc. v. Amazon.com, Inc., et al.</i> , No. 2:22-cv-00433-RWS-RSP (E.D. Tex. May 15, 2023)
1044	Docket Control Order, <i>Textron Innovations Inc., v. SZ DJI Tech. Co., Ltd., et al.</i> , No. 2:22-cv-0351-RWS-RSP (E.D. Tex. May 11, 2023)
1045	“Time to Milestones – Judges: Robert W. Schroeder, III Case Filing Date: On or After Jan. 1st, 2008,” Docket Navigator
1046	Dell’s Opposed Motion for Stay Pending IPR, <i>AX Wireless LLC v. Dell Inc. et al.</i> , No. 2:22-cv-00277-RWS-RSP (E.D. Tex. Mar. 13, 2024), ECF No. 179
1047	Comparison between the current Petition and petition in IPR2023-01145