

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

DELL INC. AND DELL TECHNOLOGIES, INC.,

Petitioners

v.

AX Wireless

Patent Owner.

IPR2024-00683

U.S. Patent 10,554,459

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT 10,554,459**

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EXHIBIT LIST

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1001	U.S. Patent 10,554,459
1002	File History of the '459 patent
1003	Declaration of Thomas LaPorta, Ph.D. in Support of <i>Inter Partes</i> Review of U.S. Patent 10,554,459
1004	Curriculum Vitae of Dr. Thomas LaPorta
1005	U.S. Patent Publication 2006/0182017 to Hansen, et al (“Hansen”)
1006	IEEE 802.11-05/0149r5, “WWiSE Proposal: High Throughput Extension to the 802.11 Standard” to Kose, et al, uploaded and publicly available on July 9, 2005 (“July 2005 WWiSE”)
1007	Declaration of James L. Lansford, Ph.D.
1008	U.S. Patent Publication 2005/0243774 to Choi, et al (“Choi”)
1009	U.S. Provisional Application 61/235,909 (“the '459 Provisional”)
1010	U.S. Patent 8,737,189 to Hansen, et al (“Hansen Patent”)
1011	U.S. Provisional Application 60/653,429 (“Hansen Provisional”)
1012	IEEE 802.11-04/0889r3, “TGn Sync Proposal Technical Specification” to Mujtaba, uploaded and publicly available on January 20, 2005
1013	IEEE 802.11-04/0886r6, “WWiSE Proposal: High Throughput Extension to the 802.11 Standard” to Hansen, et al, uploaded and publicly available on January 6, 2005 (“January 2005 WWiSE”)
1014	U.S. Patent Publication 2007/0115802 to Yu (“Yu”)
1015	IEEE Std. 802.11a-1999, “Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: High-Speed Physical Layer in the 5 GHz Band”, approved September 16, 1999 (“802.11a”)
1016	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:

Exhibit	Reference
	High-Speed Physical Layer in the 5 GHz Band, date of publication December 30, 1999
1017	IEEE Std. 802.11n-2009, “Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Amendment 5: Enhancements for Higher Throughput” (“802.11n”)
1018	Editor for G.9960, “ITU-T Recommendation G.9960 Next Generation Wire-line Based Home Networking Transceivers-Foundation”, ITU-T SG15/Q4, January 2009, as filed in file wrapper of the ’459 patent
1019	Intellon Corporation, “G.hn: Extended PHY frame header,” ITU-T SG15/Q4, 09XC-119, Xian, China, July 2009, as filed in file wrapper of the ’459 patent
1020	CopperGate Communication, “G.hn: Using Two Symbols for the Header of a PHY frame on Coax,” ITU-T SG15/Q4, 09XC-100, Xian, China July 2009, as filed in file wrapper of the ’459 patent
1021	J. Lörincz, et al, “Physical Layer Analysis of Emerging IEEE 802.11n WLAN Standard”, 8th International Conference Advanced Communication Technology (February 20-22, 2006); added to IEEE <i>Xplore</i> May 8, 2006
1022	R. Van Nee, et al., “OFDM for Wireless Multimedia Communications”, Artech House Publishers (2000)
1023	A. Bahai, et al., “Multi-Carrier Digital Communications Theory and Applications of OFDM”, Springer (2004)
1024	D. Tse, et al., “Fundamentals of Wireless Communication”, Cambridge University (2005)
1025	J. Heiskala, et al., “OFDM Wireless LANs: A Theoretical and Practical Guide”, Sams Publishing (2002)
1026	RESERVED
1027	J. Cox, “Stage Set for Compromise on IEEE High-Speed Wireless”, Network World (March 21, 2005)
1028	M. Reardon, “New Wi-Fi Standard Takes the Slow Road”, CNET (May 20, 2005)

Exhibit	Reference
1029	S. Mujtaba, et al., IEEE 802.11-05/786r0, “TGn Sync, WWiSE, and Mitmot Closing Report”, presentation submission, submitted and publicly available on July 21, 2005.
1030	S. Coffey, IEEE 802.11-05/0737r0, “WWiSE IEEE 802.11n Proposal”, presentation submission, submitted and publicly available on July 9, 2005
1031	M. Gast, “802.11 Wireless Networks: The Definitive Guide”, O’Reilly (2002)
1032	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
1033	U.S. Patent 7,415,074 (Appendix C to DELL-1007)
1034	A. Stephens, “802.11 ‘Decrypted’”, ACM SIGCOMM Computer Communication Review, Vol. 35, No. 2 (April 2005) (Appendix D to Lansford Declaration, DELL-1007).
1035	R. Kay, “Sidebar: The Battle for 11n”, ComputerWorld (March 13, 2006)
1036	“‘WWiSE’ Consortium, Motorola Team on Proposal for IEEE 802.11n”, Wireless Design Online (February 24, 2005)
1037	WWiSE Industry Organization Press Release, “‘WWiSE’ Consortium and Motorola Team to Offer Enhanced Proposal for IEEE 802.11n” (February 24, 2005); <i>archived</i> on April 6, 2005 at https://web.archive.org/web/20050406073808/http://www.wwise.org/pressreleasefeb23.htm .
1038	IEEE 802.11-04/422r4, “New Participant Orientation”, presentation submission (July 2004) (Appendix A to Lansford Declaration, DELL-1007)
1039	IEEE 802.11-04/736r1, “Approved Minutes of the IEEE P802.11 Full Working Group”, Minutes (July 2004) (Appendix B to Lansford Declaration, DELL-1007)
1040	B. O’Hara, The IEEE 802.11 Handbook, Standards Information Network, IEEE Press, 1999

Exhibit	Reference
1041	Jan. 11, 2024 Letter from Sarah Piepmeier letter to Kevin Wheeler regarding Dell Stipulation
1042	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
1043	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
1044	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)
1045	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)
1046	“Time to Milestones – Judges: Robert W. Schroeder, III Case Filing Date: On or After Jan. 1st, 2008,” Docket Navigator
1047	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
1048	Comparison between the current Petition and petition in IPR2023-01138

I. Introduction

Dell Inc. and Dell Technologies Inc. (collectively, “Dell” or “Petitioner”) petition for *inter partes* review (“IPR”) of U.S. Patent 10,554,459 (“the ’459 patent”; DELL-1001) claims 1-3, 5, 7-11, and 13.

II. Grounds For Standing

Dell certifies the ’459 patent is available for IPR, and Dell is not barred or estopped from requesting IPR.

III. Identification Of Challenge

A. Prior Art

The ’459 patent claims priority through a series of continuations to U.S. Patent 9,584,262, filed August 20, 2010. The ’459 patent also claims benefit to Provisional Application 61/235,909, filed August 21, 2009 (“’459 Provisional”; DELL-1009). Petitioner does not acquiesce that the ’459 patent is entitled to priority to any of these prior applications. Regardless, each reference was published or issued prior to August 21, 2009.

1. **U.S. Patent Publication 2006/0182017 to Hansen, et al** (“Hansen”; DELL-1005), published August 17, 2006, is prior art under pre-AIA 35 U.S.C. §102(b).

2. **“WWiSE Proposal: High throughput extension to the 802.11 Standard” to Kose, et al** (“July 2005 WWiSE”; DELL-1006) is prior art under

pre-AIA 35 U.S.C. § 102(b) because the document was available and accessible to the public on July 9, 2005. (See DELL-1007, ¶24.) July 2005 WWiSE was a submission made to Task Group n (“TGn”) of the IEEE 802.11 Wireless Local Area Networks (“WLAN”) Working Group. During the 2004-2005 timeframe, IEEE Working Group members could provide submissions. (DELL-1007, ¶15.) Members made these submissions through the IEEE 802 Wireless World website, <http://802wirelessworld.com>. (DELL-1007, ¶16; DELL-1038 (New Participant Orientation Slides), 35-37; DELL-1039 (July 2004 Meeting Minutes), 5.)

All submissions were accessible to any member of the public after free registration through the Wireless World website. (DELL-1007, ¶18; DELL-1038 (New Participant Orientation Slides), 25-30 (describing process of becoming a member).) After creating an account, an individual could view the “Working Group Document Listing” and download any submissions that had been uploaded. (DELL-1038 (New Participant Orientation Slides), 35; DELL-1007, ¶18.)

Submissions were also publicly available to any member of the public via FTP at <ftp.wirelessworld.com>. (DELL-1007, ¶19; DELL-1038 (New Participant Orientation Slides), 35 (describing process for creating a free account).) The FTP server’s address and login credentials were also publicly available. (DELL-1007, ¶19, citing DELL-1033 and DELL-1034)).

In mid-2007, the IEEE's current Mentor website ("Mentor") replaced the Wireless World website. (DELL-1007, ¶21.) Prior submissions uploaded to the Wireless World server were added to Mentor shortly after its creation. (DELL-1007, ¶21.) The uploaded documents retained their original submission upload dates. (DELL-1007, ¶21.) Mentor and all its documents have been freely available to members of the public since soon after its creation in 2007 and before August 21, 2009. (DELL-1007, ¶21.) Entries in Mentor were and remain searchable by year, task group, title, or other parameters. (DELL-1007, ¶22.)

July 2005 WWiSE was uploaded to the IEEE database on July 9, 2005, at which time it would have been available to interested members of the public through the Wireless World website or by FTP. (DELL-1007, ¶¶18-29, 24.) After mid-2007 and before August 21, 2009, July 2005 WWiSE would have been available to interested members of the public through Mentor. (DELL-1007, ¶¶18-18, 21, 24.) Interested members of the public would have been aware of the proposals made to IEEE by WWiSE because they were frequently discussed in 2004 and 2005 in industry publications. (See, e.g., DELL-1021, DELL-1027, DELL-1035; DELL-1036; DELL-1037.)

For at least these reasons, July 2005 WWiSE was publicly accessible prior to the earliest possible priority date of the '459 patent to a person of ordinary skill in

the art (“POSITA”) exercising reasonable diligence. See *GoPro, Inc. v. Contour IP Holding LLC*, 908 F.3d 690, 693 (Fed. Cir. 2018).

3. **U.S. Patent Publication 2005/0243774 to Choi, et al** (“Choi”; DELL-1008), published November 3, 2005, is prior art under 35 U.S.C. §102(b).

None of the applied references were cited in or discussed during prosecution of the ’459 patent or cited in or discussed during prosecution in any of the patents to which the ’459 patent claims priority, weighing heavily against discretionary denial under 35 U.S.C. §325(d).

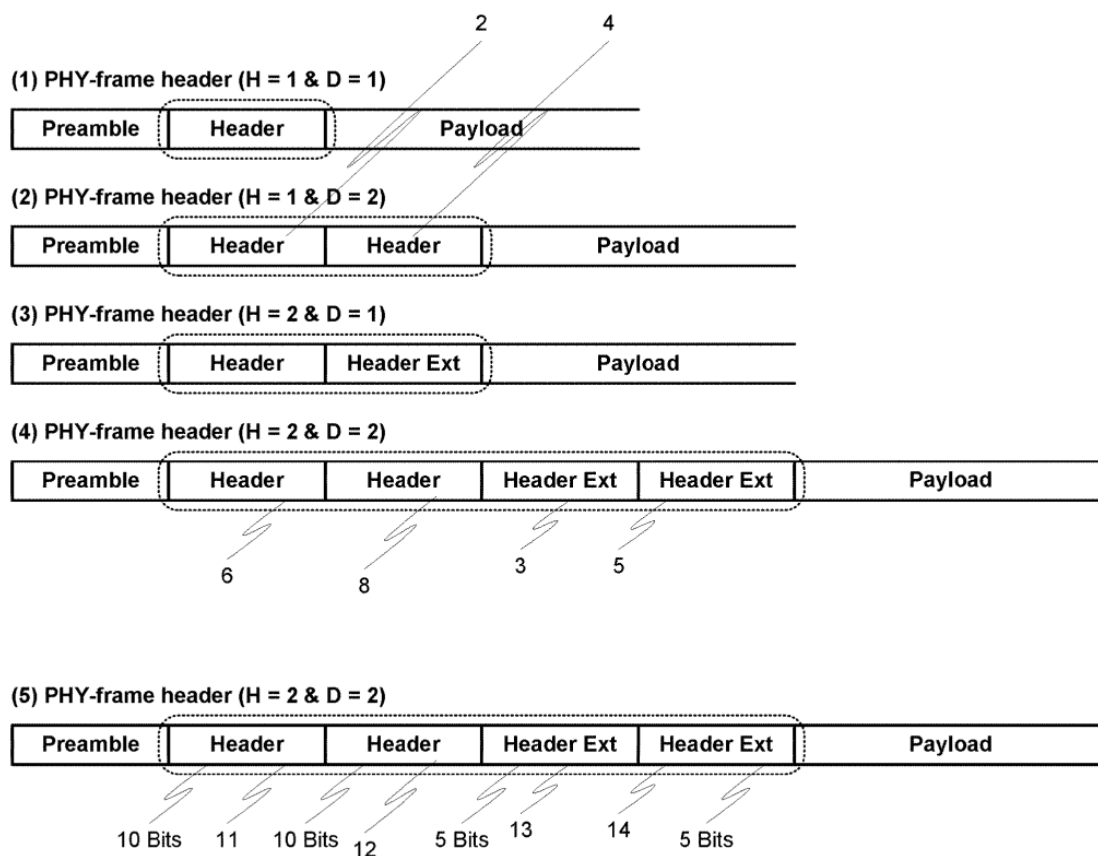
B. Grounds For Challenge

Ground		Claims	Prior Art
1	103	1-3, 5, 7-11, 13	Hansen and July 2005 WWiSE
2	103	1-3, 5, 7-11, 13	Hansen, July 2005 WWiSE, and Choi

IV. ’459 Patent Overview

The ’459 patent is “directed toward header repetition in a communications environment.” (DELL-1001, 1:31-34.) The ’459 patent describes four different header configurations, illustrated in Figure 1. The value of D in Figure 1 corresponds to the number of repetitions of the header and the value of H in Figure 1 corresponds to the number of symbols required for a single header (e.g., whether the header is extended). In the first example where H=1 and D=1, the packet includes a “preamble followed by a header followed by a payload.” (DELL-1001,

5:51-53.) This example represents a simple “one-part” header field. In the second example where $H=1$ and $D=2$, the packet includes a preamble followed by a header that is repeated, which is followed by the payload. (DELL-1001, 5:53-55.) This “repeated header” example includes a “two-part” header field with each part carrying the same information. (DELL-1001, 5:55-57.)



'459 Patent, Figure 1

In the third example where $H=2$ and $D=1$, the packet includes a preamble and a header followed by a header extension and the payload. (DELL-1001, 5:57-59.) This “extended header” example is also a “two-part” header field but in this

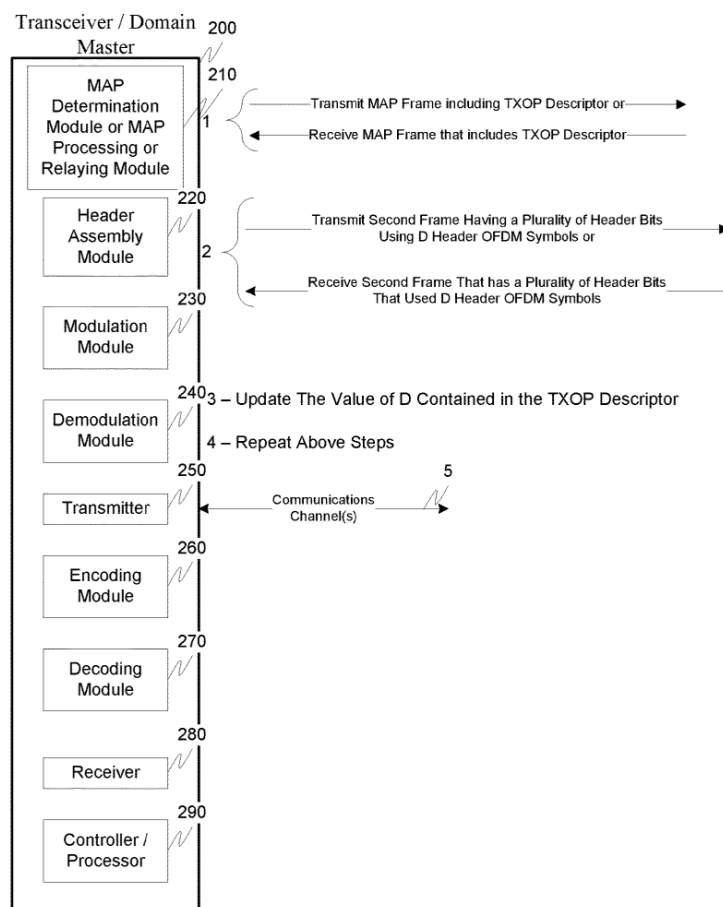
example the two parts carry **different** information. (*See, e.g.*, DELL-1001, 5:65-6:2.) And in the fourth example where $H=2$ and $D=2$, the packet includes a preamble, a header which is repeated, and a header extension which is also repeated, followed by the payload. (DELL-1001, 5:59-62.) This “repeated, extended header” example is a “four-part” header field with the first and second parts carrying the same information and the third and fourth parts carrying the same information. (DELL-1001, 5:62-64.) In the Notice of Allowance, the Examiner pointed to the third and fourth example as the basis for allowance, finding the “prior art of record fails to disclose the first header field (i.e., Figure 1 “(3)”) and the second header field (i.e., Figure 1 “(4)”). (DELL-1002 (NOA), 2.)

The extended and/or repeated headers of the '459 patent can be used in communications systems such as ITU G.9960 (G.hn) and IEEE 802.11 that use “frame-based (or packet-based) transmission to communication [sic] between two or more users over a shared channel based on Orthogonal Frequency Division Multiplexing (OFDM¹).” (DELL-1001, 1:38-47; *see also, id.*, 4:33-50.) The '459 patent acknowledges that, prior to its earliest possible priority date, G.9960 “has defined two overlapped baseband bandplans, 50MHz-PB and 100MH-PB” and the “possibility of having narrower bandplans such as 25 MHz-PB and 12.5 MHz-PB

¹ An acronym list is provided in Appendix B.

are under discussion.” (DELL-1001, 2:19-22; *See also, id.*, 1:56-58 (noting that G.9960 “should be familiar to those skilled in the art”).) Thus, the ’459 patent admits the existing ITU G.9960 standard supported two channel bandwidths—one at least two times wider than the other.

The generic transceiver 200 described for use in these systems includes header assembly module 220, modulation module 230, demodulation module 240, transmitter 250, encoding module 260, decoding module 270, receiver 280, and controller/processor 290. (DELL-1001, 6:14-22; Figure 2 below.)



’459 patent, Figure 2

Applicant, Applied Transform, LLC, did not invent the concept of extending the header of an OFDM packet, nor did the Applicant invent the concept of repeating the OFDM packet header. To the contrary, these two concepts were publicly disclosed and openly discussed prior to August 21, 2009, during development of the ITU-T G.hn (next generation home network technology) standards—a fact PO openly admits in its provisional application. (*See* DELL-1009, 21-22; DELL-1019; DELL-1020; DELL-1003, ¶¶37-38.)

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. (DELL-1012, 133:7-134:2 (disclosing a 2 symbol (“extended”) header); DELL-1006, 69:16-19, 67:1-69:17 (Figures 007-Figure 016, illustrating duplicate SIG-N header fields); DELL-1003, ¶38.)

The challenged claims of the ’459 patent therefore do nothing more than co-opt ideas disclosed in standards submissions from other companies and wrap these ideas onto a broadly recited, yet extremely well-known, wireless OFDM transceiver architecture.

A. Level Of Ordinary Skill In The Art

A POSITA at the time of the purported invention 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. (DELL-1003, ¶62.)

B. Claim Construction

Claim terms are typically given their ordinary and customary meanings as understood by a POSITA at the time of the invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-16 (Fed. Cir. 2005) (en banc). Petitioner does not believe it is necessary for the Board to expressly construe any term for the purpose of this IPR proceeding. *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

V. GROUND 1: Combination of Hansen and July 2005 WWiSE Renders Claims 1-3, 5, 7-11, and 13 Obvious.

A. Combination Overview

1. Hansen

Hansen is U.S. Patent Publication of Application 11/151,772 which matured into U.S. Patent 8,737,189 ("Hansen Patent"; DELL-1010). Hansen relates to "compromise green field preambles for 802.11n." (DELL-1005, ¶7.)

Hansen explained that IEEE 802.11 task group N (“TGn”) was “chartered to develop a standard to enable WLAN devices to achieve throughput rates beyond 100 Mbits/s” which will “be documented in IEEE resolution 802.11n.” (DELL-1005, ¶9.) According to Hansen, one objective of TGn was to “enable WLAN devices compatible with IEEE 802.11n to also interoperate with IEEE 802.11 devices that are not compatible with IEEE 802.11n” (referred to as “legacy” devices). (DELL-1011, ¶38; *see also*, DELL-1005, ¶32, DELL-1005, ¶¶1, 6 (incorporating Hansen Provisional by reference).) This “backward compatible” access is referred to as “mixed mode access.” (DELL-1005, ¶32.) In mixed mode access, a physical layer frame includes “legacy” information for non-IEEE 802.11n compatible devices and 802.11n information for IEEE 802.11n compatible devices. (*See* DELL-1005, ¶32.)

TGn also recognized IEEE 802.11n-compatible devices that only communicate with other IEEE 802.11n-compatible devices can operate in a greenfield access mode. (DELL-1005, ¶32.) In greenfield mode, the physical layer frame (packet) does not require inclusion of the “legacy” information and can therefore be shortened to omit that information, further improving throughput. (*See* DELL-1005, ¶27; *see, e.g.*, DELL-1011, ¶55 (describing efficiency gain with greenfield); DELL-1005, ¶¶1, 6.)

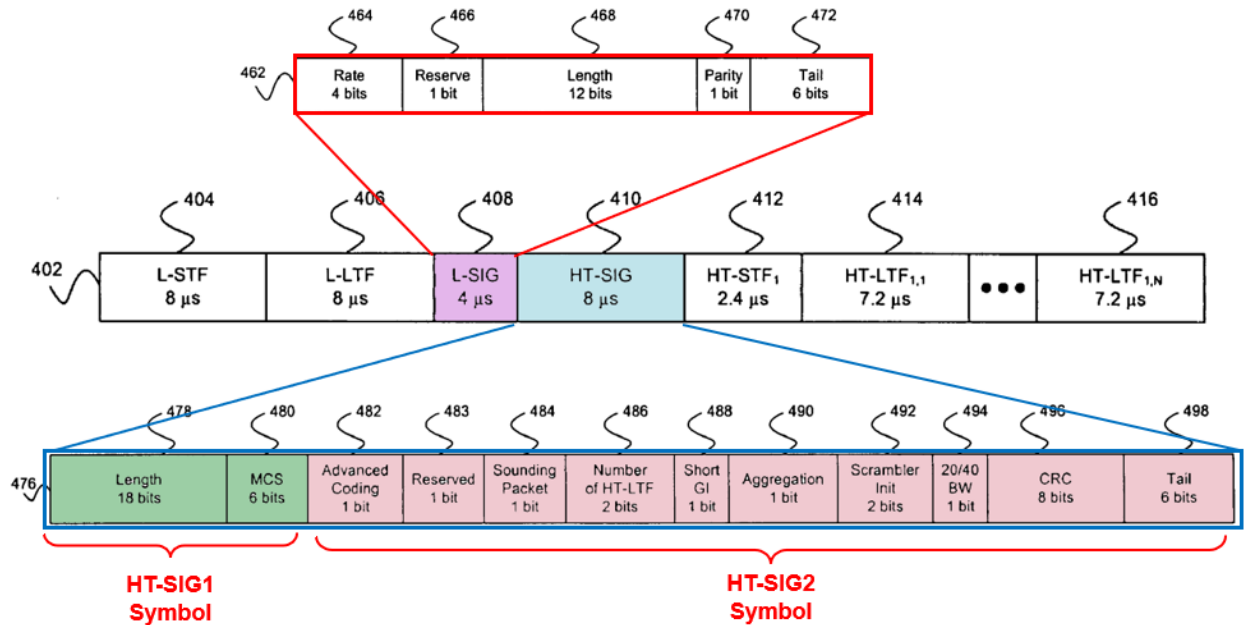
Two competing proposals emerged in TGn as “candidates for incorporation in IEEE 802.11n.” (DELL-1005, ¶9.) The first proposal, from the TGn Sync industry group, provided a mechanism to support mixed mode access but did “not provide a mechanism to support greenfield access.” (DELL-1005, ¶33.) The second proposal, from the Worldwide Spectrum Efficiency (WWiSE) industry group, provided mechanisms to support both greenfield and mixed mode access. (*See, e.g.*, DELL-1006, 67:1-69:7 (depicting mixed mode and greenfield training structures).) Hansen sought to bridge the gap between these two competing proposals. (*See, e.g.*, DELL-1005, Title, ¶¶7, 11, 27.)

a. TGn Sync Proposal²

Hansen first describes the mixed mode physical protocol data unit (PPDU) preamble and header from the TGn Sync proposal. (*See* DELL-1005, ¶¶61-76.) This preamble and header 402, illustrated below for a single spatial stream, comprises a legacy (L) portion to be used by non-802.11n devices and a High Throughput (HT) portion to be used by 802.11n devices. (DELL-1005, ¶61, Figure 4a, *compare* DELL-1012, 131:10-13, 121:1-2 (Figure 55).) The legacy portion

² DELL-1012 is a copy of the January 2005 TGn Sync proposal underlying Hansen’s discussion. (*See* DELL-1007, ¶31 (discussing the public availability of the January 2005 TGn Sync Proposal on January 20, 2005); DELL-1003, ¶69.)

includes a 24-bit (one symbol) header field (L-SIG), shaded pink in annotated Figure 4a (below, middle) and illustrated in Figure 4b (below, top). (DELL-1005, ¶¶62, 66, *compare* DELL-1012, 131:10-13, 121:1-2 (Figure 55).)



Hansen, Annotated Figures 4b (top), 4a (middle), 4c (bottom)

The HT portion includes a 48-bit, two symbol header field (HT-SIG), shaded blue in annotated Figure 4a (above, middle) and illustrated in annotated Figure 4c (above, bottom). (See DELL-1005, ¶¶62, 67 (HT-SIG header field “for mixed mode access **in accordance with a TGn Sync proposal**”); *compare* DELL-1012, 134:1-2 (Figure 62), 121:1-2 (Figure 55).) The part of HT-SIG (shaded green in annotated Figure 4c above, bottom), corresponding to one symbol in the transmitted PPDU, includes length and modulation and coding scheme (MCS)

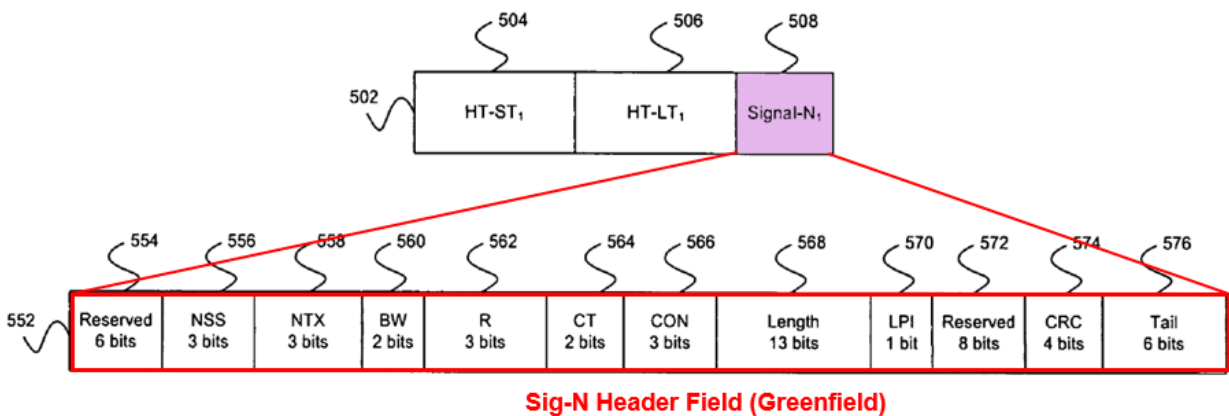
fields. (See DELL-1005, ¶67; DELL-1012, 134:1-2 (mapping first 24 bits of HT-SIG field to first symbol.) The TGn Sync proposal refers to this part of the HT-SIG header field as HT-SIG1. (DELL-1012, 134:1-2.) The second part (shaded red in annotated Figure 4c above, bottom), corresponding to a second symbol in the transmitted PPDU, includes, among other fields, the advanced coding, sounding packet, number of HT-LTF, and 20/40 bandwidth fields. (See DELL-1005, ¶67; DELL-1012, 134:1-2 (mapping second 24 bits of HT-SIG field to second symbol).) The TGn Sync proposal refers to this part of the HT-SIG header field as HT-SIG2. (DELL-1012, 134:1-2.) For ease of discussion, Petitioner adopts the HT-SIG1 and HT-SIG2 terminology used in the TGn Sync proposal to refer to the separate parts of the two-part HT-SIG header field.

b. January 2005 WWiSE Proposal³

Unlike the TGn Sync proposal, the January 2005 WWiSE proposal referenced in Hansen includes PPDU's for both mixed mode and greenfield access.

³ DELL-1013 is a copy of the WWiSE proposal by Hansen that forms the basis of Hansen's WWiSE discussion. (See DELL-1007, ¶¶25-26 (discussing the public availability of the January 2005 WWiSE proposal); DELL-1003, ¶74.) Petitioner refers to this as the "January 2005 WWiSE" proposal to distinguish it from the July 2005 WWiSE proposal used as a reference in Petitioner's Grounds.

(See, e.g., DELL-1013, 50:16-52:7 (Figures 007-016).) The training and header fields 502 for an exemplary January 2005 greenfield PPDU are illustrated in Figure 5a below (top) for a single spatial stream. (DELL-1005, ¶77.) Training and header fields 502 include a Signal-N header field 508 (shaded pink), illustrated in Figure 5b below (bottom). (DELL-1005, ¶¶77, 79, compare DELL-1013, 50:16-18 (Figure 007), 53:8-10.)

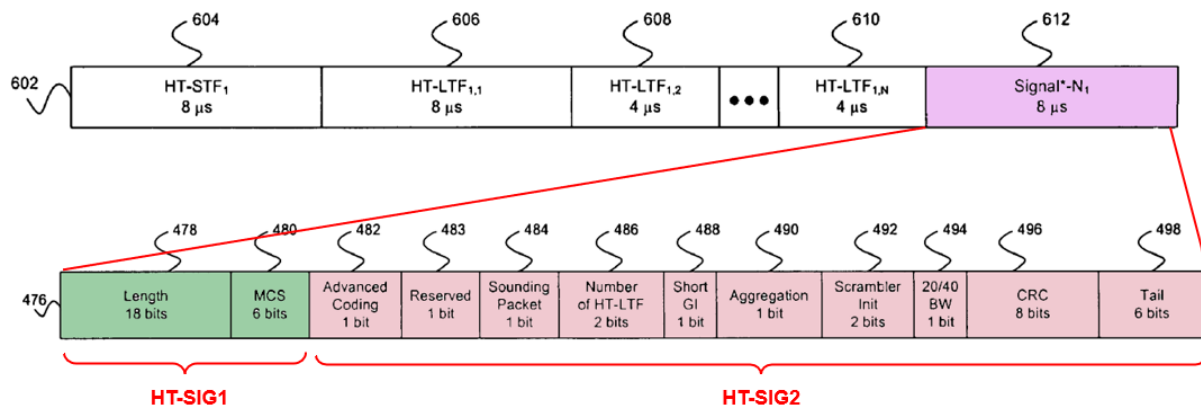


Hansen, Excerpt for Annotated Figure 5a (top), Figure 5b (bottom)

c. Hansen’s Greenfield PPDU

Hansen next presents a “compromise” PPDU that combines WWiSE’s concept of a greenfield PPDU with a TGn Sync-style format for HT fields. (Compare DELL-1005, Figures 4a, 5a, and 6a.) By using TGn Sync’s HT-SIG field, the “compromise” PPDU also includes a “sounding field”, not present in the January 2005 WWiSE proposal. (See DELL-1005, ¶27.) The training and header fields of Hansen’s “compromise” greenfield PPDU are illustrated in the excerpt

from Figure 6a below showing a single spatial stream. (See DELL-1005, ¶¶87-110.) Hansen’s training and header fields include short and long training fields (HT-STF/HT-LTF) and a Signal*-N₁ field 612 (shaded pink). (DELL-1005, ¶87.) The Signal*-N₁ field 612 is “represented as described in Fig. 4c” which, as discussed above, discloses the two-part extended HT-SIG field (shaded green (first part) and shaded red (second part)) from the TGn Sync proposal. (DELL-1005, ¶97 (“the Signal*-N field be [sic] represented as described in FIG. 4c”).) The embodiment using the header field (HT-SIG) from Figure 4c in Figure 6a’s preamble and training fields is referred to herein as “Hansen’s ‘compromise’ greenfield PPDU.”



Hansen, Excerpt from Annotated Figure 6a (top); Figure 4c (bottom)

2. July 2005 WWiSE

July 2005 WWiSE is a proposal submitted to the TGn working group by the WWiSE industry group building on the January 2005 proposal discussed in

Hansen. (DELL-1006, 1.) Specifically, July 2005 WWiSE adds an extended range (ER) capability for 802.11n compliant devices. (DELL-1006, 1, 31, 46-48, 50, 67-70.)

The format of a July 2005 WWiSE greenfield PPDU, illustrated in Figure 001 below, consists of a preamble, the Signal-N field (also referred to as SIG-N), and data. (DELL-1006, 58:17-19.)

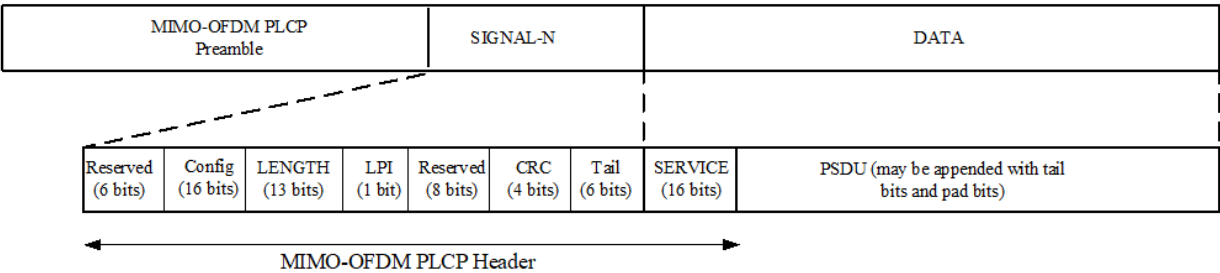


Figure 001 – PPDU frame format: Greenfield access in the 1TX (40 MHz) and 2TX (20 and 40 MHz) modes

July 2005 WWiSE’s SIGNAL-N (SIG-N) field “is separately defined for a mandatory standard configuration and an optional ‘extended communication range’ configuration (ER).” (DELL-1006, 69:10-11.) In the mandatory standard configuration (also referred to as normal range (NR)), “SIG-N is composed of a **single MIMO-OFDM symbol** that provides all length and configuration parameters” associated with the greenfield PPDU. (DELL-1006, 69:13-14.)

In the extended 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-

1006, 69:16-18.) July 2005 WWiSE refers to this two-symbol SIG-N field as “the long SIG-N field format.” (DELL-1006, 50:9-10.) The second OFDM symbol (designated ER-SIG-N) in the long SIG-N field duplicates (repeats) the information carried in the SIG-N symbol, as illustrated in Figure 011 below. (DELL-1006, 68:1-2 (referencing the “optional **duplicate** SIG-N”, designated as ER-SIG-N); *see also*, Figures 007-016 (including the “optional duplicate SIG-N for extended range communication”).)

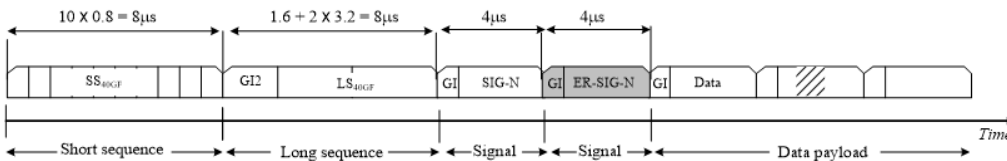


Figure 011 – MIMO-OFDM Training structure for $N_{TX}=1$, 40 MHz, greenfield operation. The shaded field indicates the optional duplicate SIG-N for extended range communication.

July 2005 WWiSE, Figure 011

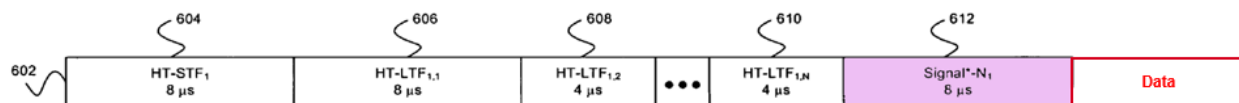
Additionally, July 2005 WWiSE applies a frequency permutation on the subcarrier indices of the OFDM data symbols composing SIG-N to derive the frequency domain OFDM symbol ER-SIG-N. (DELL-1006, 69:18-25.)

July 2005 WWiSE also added a one-bit field to the SIG-N field, the REXT bit, to indicate whether the device was operating in standard configuration or ER configuration. (DELL-1006, 69:30-31, 70:6-7.) July 2005 WWiSE explains that “Extended Range (ER) capable devices are devices which support the optional Extended Range MCS, in addition to the Normal Range (NR) MCS, and the long

SIG-N field format.” (DELL-1006, 50:9-11.) ER frames (PPDUs) “shall be transmitted with the long SIG-N field format and the REXT bit set to value 1.” (DELL-1006, 50:12-13.) For NR frames (PPDUs), the optional repeated header symbol (ER-SIG-N) is not included and the REXT bit is set to value 0. (See DELL-1006, 50:12-13; 70:6-7 (value 0 of REXT “indicates the standard configuration”).)

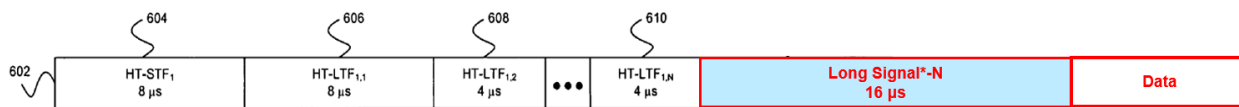
3. Motivation to Combine

A POSITA would have been motivated to combine the teachings of Hansen with the teachings of July 2005 WWiSE. (DELL-1003, ¶87.) Specifically, a POSITA would have been motivated to combine July 2005 WWiSE’s ER communication teachings (§V.A.2) with Hansen’s “compromise” green field PDU (§V.A.1.c) to support both NR and ER capabilities in a single greenfield-compatible device. (DELL-1003, ¶87.) In the combination, Hansen’s “compromise” greenfield PDU is used for standard, or normal range (NR) communication and is referred to herein as the NR green field PDU.



NR Greenfield PDU
(Combined Hansen Figure 3a and Excerpt from Figure 6a)

ER communication in the combination of Hansen and July 2005 WWiSE repeats the two parts of Hansen's Signal*-N header field, as taught by July 2005 WWiSE. (*See, e.g.*, DELL-1006, 69:16-18, 68:1-2; *see also*, Figures 007-016 (including the "optional duplicate SIG-N for extended range communication").) This header repetition creates a "Long Signal*-N", illustrated in the figure below, which duplicates HT-SIG1 and HT-SIG2 of Hansen's Signal*-N header field and therefore occupies 4 OFDM symbols when transmitted or received. (*See* DELL-1006, 50:9-10 (describing use of the "long SIG-N" field for ER communication); DELL-1003, ¶89.) For ease of discussion, Petitioner refers to the duplicated version of the header symbols HT-SIG1 and HT-SIG2 as ER-HT-SIG1 and ER-HT-SIG2 respectively. The greenfield PPDU used for ER communication in the combination of Hansen and July 2005 WWiSE, illustrated below, is referred to herein as the ER green field PPDU.



ER Greenfield PPDU
(Combined Hansen Figure 3a and Excerpt from Figure 6a,
as modified by July 2005 WWiSE)

In the combination, the frequency permutation described in July 2005 WWiSE for the repeated header symbol is applied to the repeated version of each

header symbol (ER-HT-SIG1 and ER-HT-SIG2). Additionally, the combination further uses a one-bit field (REXT) in the header to indicate whether the device is operating in standard (NR) or ER mode. (See DELL-1006, 69:30-31, 70:6-7.) A POSITA would have understood that the reserved field of the HT-SIG2 part of Signal*-N and Long Signal*-N would be used to carry this REXT information. (DELL-1003, ¶90; *see also*, DELL-1005, ¶67 (reserved field not utilized).)

A POSITA would have been motivated to combine Hansen and July 2005 WWiSE as described above for numerous reasons. (DELL-1003, ¶91.) First, Hansen repeatedly suggests the combination. Hansen describes the earlier January 2005 WWiSE proposal and TGn Sync proposal submitted to TGn. (DELL-1005, ¶33.) Hansen defined a compromise proposal based on aspects of both January 2005 WWiSE and the TGN Sync proposal. (DELL-1005, Title (“Method and system for compromise green field preambles for 802.11n”), ¶¶7, 11, 27; *see also*, DELL-1011, 14.) Based on Hansen’s suggestion to bridge the gap between the WWiSE and TGn Sync industry groups, a POSITA would have been motivated to combine July 2005 WWiSE with Hansen to incorporate the newly introduced aspects of the July 2005 WWiSE proposal, including support for the ER capability, into the Hansen’s green field PPDU. (DELL-1003, ¶¶91-92; *see also*, DELL-1006, 1, 31, 46-48, 50, 67-70.) Indeed, others in the field recognized the critical need to

merge these two competing proposals to reach a final version of the 802.11n standard. (*See, e.g.*, DELL-1027, 1; DELL-1028, 1; DELL-1021, 1.)

Second, a POSITA would have been motivated to incorporate July 2005 WWiSE's ER capability into Hansen's greenfield PPDU to extend the range of successful communication between devices. (DELL-1003, ¶93.) In fact, July 2005 WWiSE expressly suggests the benefit of including an ER capability, stating: "A characteristic of ER MCS is that they have a longer range than NR MCS." (DELL-1006, 50:15.) An ER capability is particularly beneficial in WLAN systems in which a potential exists for the receiver to move a significant distance from the transmitter. (DELL-1003, ¶93, *citing* DELL-1030, 21-22.) As the distance between transmitter and receiver increases, the communications channel is subjected to increased fading. (DELL-1003, ¶93.) The ER capability of July 2005 WWiSE achieves communications at a greater distance through the introduction of diversity into its transmitted frames (PPDU). Specifically, as discussed in §V.A.2, July 2005 WWiSE uses both temporal diversity (repeated header field) and frequency diversity (frequency permutation on duplicated version of header field) to provide ER capability. This introduction of two additional forms of diversity makes the header (Signal-N) field more decodable for a given signal power, improving the receiver gain and allowing weaker signals to be received and decoded more effectively. (DELL-1003, ¶93.) A POSITA would have therefore been motivated to

combine July 2005 WWiSE's ER capability into Hansen's system to achieve better coverage at a greater distance.

Third, a POSITA would have been motivated to include the capability for an ER capable device to turn on or off ER operation using a header bit (REXT). (*See* §V.A.2.) For example, a POSITA would have understood that a transmitter is motivated to transmit at the highest speed achievable based on the current conditions of a channel. (DELL-1003, ¶94.) Therefore, an ER capable device would start communication in NR mode and move to ER mode if channel conditions become bad and messages are dropping. (DELL-1003, ¶94.) In such circumstances, an ER-capable station can utilize ER to successfully communicate, at the cost of some throughput reduction, a tradeoff that was already familiar to a POSITA long before August 21, 2009. (DELL-1003, ¶94; *see, e.g.*, DELL-1014, ¶80 (“repetition of the OFDM symbol and a diversity effect due to the subcarrier allocation may be achieved, the transmission speed may be reduced by half, **but a service radius may be increased to 50% to 100%**”).)

Fourth, a POSITA would have been motivated to combine Hansen and July 2005 WWiSE because the combination is merely the application of a known technique (July 2005 WWiSE's ER capability) to a known device (device with Hansen's “compromise” greenfield PPDU) ready for improvement and use of a known technique (July 2005 WWiSE's ER capability) to improve similar devices

(device with Hansen's "compromise" greenfield PPDU) in the same way (providing ER capability). *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 415-421 (2007). The addition of ER capability to Hansen would have been seen by a POSITA as an improvement to a device using Hansen's "compromise" greenfield PPDU because ER extends the range of reliable communication between a transmitter and receiver by providing diversity to overcome environmental conditions (e.g., fading and/or noise). (DELL-1003, ¶95.) A POSITA would have applied the known improvement (ER capability of July 2005 WWiSE) in the same way to Hansen because Hansen's "compromise" greenfield PPDU has a similar structure to the greenfield PPDU disclosed in WWiSE. (DELL-1003, ¶95; *compare* DELL-1005, Figure 5a *with* DELL-1006, Figure 007.)

Fifth, the combination further merely combines prior art elements according to known methods. *See KSR*, 550 U.S. at 416. The combination repeats the header field and uses a one-bit reserved sub-field to indicate whether ER operation is enabled. (DELL-1003, ¶96.) A POSITA would have known how to make these modifications to Hansen's "compromise" greenfield PPDU because the addition of fields and the use of reserved fields was commonly done to support modifications or customizations to a standard such as IEEE 802.11 long before August 21, 2009. (DELL-1003, ¶96.) For example, both Hansen and July 2005 WWiSE discuss modifications to the existing 802.11a PPDU, including the addition of fields.

(DELL-1003, ¶96.) A POSITA would have also known how to integrate the frequency permutation of July 2005 WWiSE because assignment of data bits to OFDM subcarriers was a basic aspect of OFDM before August 2009. (DELL-1003, ¶96.)

The results of the combination of Hansen and July 2005 WWiSE would have been predictable and a POSITA would have had a reasonable expectation of success in the combination. (DELL-1003, ¶97.) Both Hansen and July 2005 WWiSE describe PPDU's for use in the 802.11n standard being developed by IEEE. (*See, e.g.* DELL-1005, Figure 6a; DELL-1006, Figure 007.) Existing 802.11 standards, which both Hansen and July 2005 WWiSE build upon, would have been extremely well-known to a POSITA by August 21, 2009. (DELL-1003, ¶97.) And as discussed above, the combination adds fields to a message, uses a reserved field to signal that ER operation is enabled (the REXT bit), and performs a frequency permutation on a symbol. (DELL-1003, ¶97.) Because such modifications were known and in fact commonplace when dealing with evolving communications technologies, the results of such modifications would have been predictable, and a POSITA would have had a reasonable expectation that the combination would operate successfully. (DELL-1003, ¶97.)

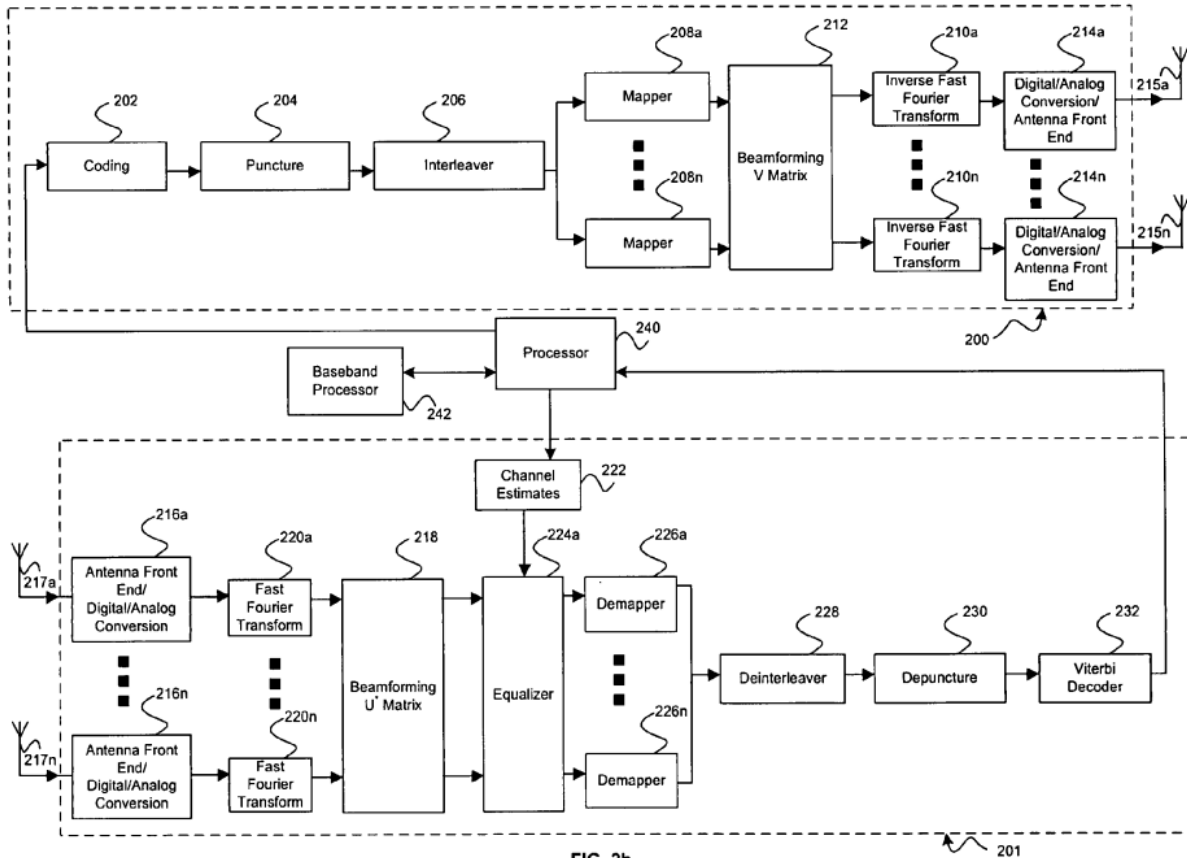
B. Independent Claim 1

The '459 patent is “directed toward header repetition in a communications environment.” (DELL-1001, 1:33-34.) Claim 1⁴ recites a “*first packet type*” having a two-part header field and a “*second packet type*” having a four-part header field. Claim 1 further recites the reception of these two packet types using “*a wireless OFDM communications receiver*” and demodulation of OFDM symbols associated with the header fields of these packet types using “*a demodulator*.” The combination of Hansen and July 2005 WWiSE renders claim 1 obvious.

1. Preamble

Petitioner does not acquiesce that the preamble is limiting. Regardless, the combination of Hansen and July 2005 WWiSE discloses a “*wireless OFDM (Orthogonal Frequency Division Multiplexing) transceiver*” [1P]. (DELL-1003, ¶¶99-101.) Hansen discloses “**a transceiver** comprising a transmitter and a receiver in a MIMO system” that transmits and receives RF signals via an antenna. (DELL-1005, ¶¶15, 49-50, Figure 2b below.)

⁴ A listing of claims is provided in Appendix A.



Hansen, Figure 2b

Transmitter portion 200 includes a “plurality of IFFT blocks 210a, ..., 210n” which “implement **orthogonal frequency division multiplexing (OFDM)**.” (See, e.g., DELL-1005, ¶48 (IFFT blocks “generat[e] a composite OFDM signal”).) Receiver portion 201 includes a “plurality of FFT blocks 220a, ..., 220n” which demodulate received signals and mathematically integrate the demodulated signals “to extract n symbols contained in **each of the plurality of OFDM signals** received by the receiver 201.” (DELL-1005, ¶51.) Because the transceiver generates OFDM signals and processes received OFDM signals, Hansen’s

transceiver is a “*wireless OFDM (Orthogonal Frequency Division Multiplexing) transceiver*” [1P]. (DELL-1003, ¶¶100-101.)

2. “Wireless OFDM Receiver” Limitations

Claim 1 recites the following limitations directed to “*a wireless OFDM communications receiver*”:

[1A] *a wireless OFDM communications receiver operable to receive, over a wireless communication channel, a first packet type in a first channel bandwidth,*

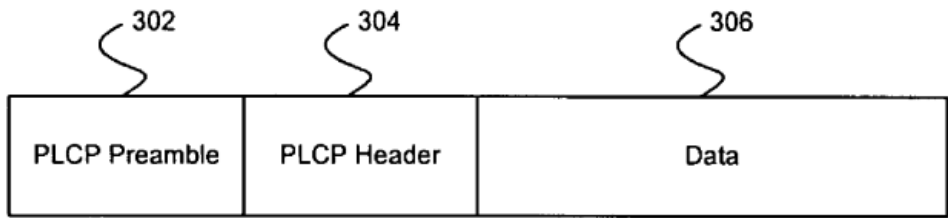
[1F] *the wireless OFDM communications receiver further operable to receive, over the wireless communications channel, a second packet type in a second channel bandwidth,*

The combination of Hansen and July 2005 WWiSE discloses these limitations. (DELL-1003, ¶¶102-146.)

a. First and Second Packet Types

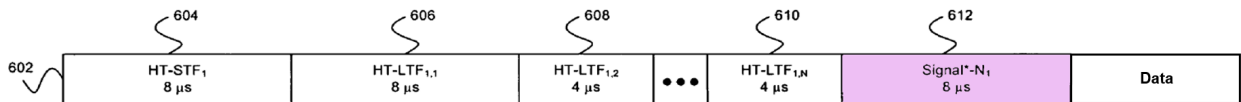
A physical layer protocol data unit (PPDU), illustrated in Hansen’s Figure 3a below, includes preamble 302, header 304, and data 306. (DELL-1005, ¶59.)

July 2005 WWiSE similarly describes a PPDU as having a preamble, header, and data. (See DELL-1006, 58:17-60:4 (illustrating PPDU frame formats).) A PPDU is a “*packet*”, consistent with the usage of the term packet in the ’459 patent. (DELL-1003, ¶¶103-105; DELL-1001, 1:43-45 (“A packet is usually formed by a preamble, header, and payload”).)

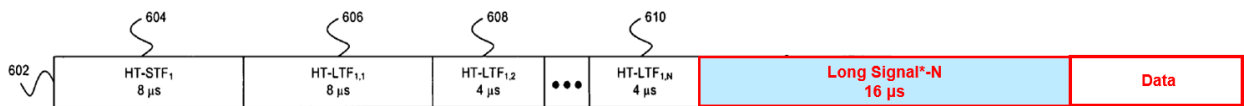


Hansen, Figure 3a

As discussed in §V.A.3, the combination of Hansen and July 2005 WWiSE includes two different types of PPDU: an NR greenfield PPDU (“*a first packet type*”) and an ER greenfield PPDU (“*a second packet type*”), illustrated below. (DELL-1003, ¶106.)



NR Greenfield PPDU (“*First Packet Type*”)
(Combined Hansen Figure 3a and Excerpt from Figure 6a)

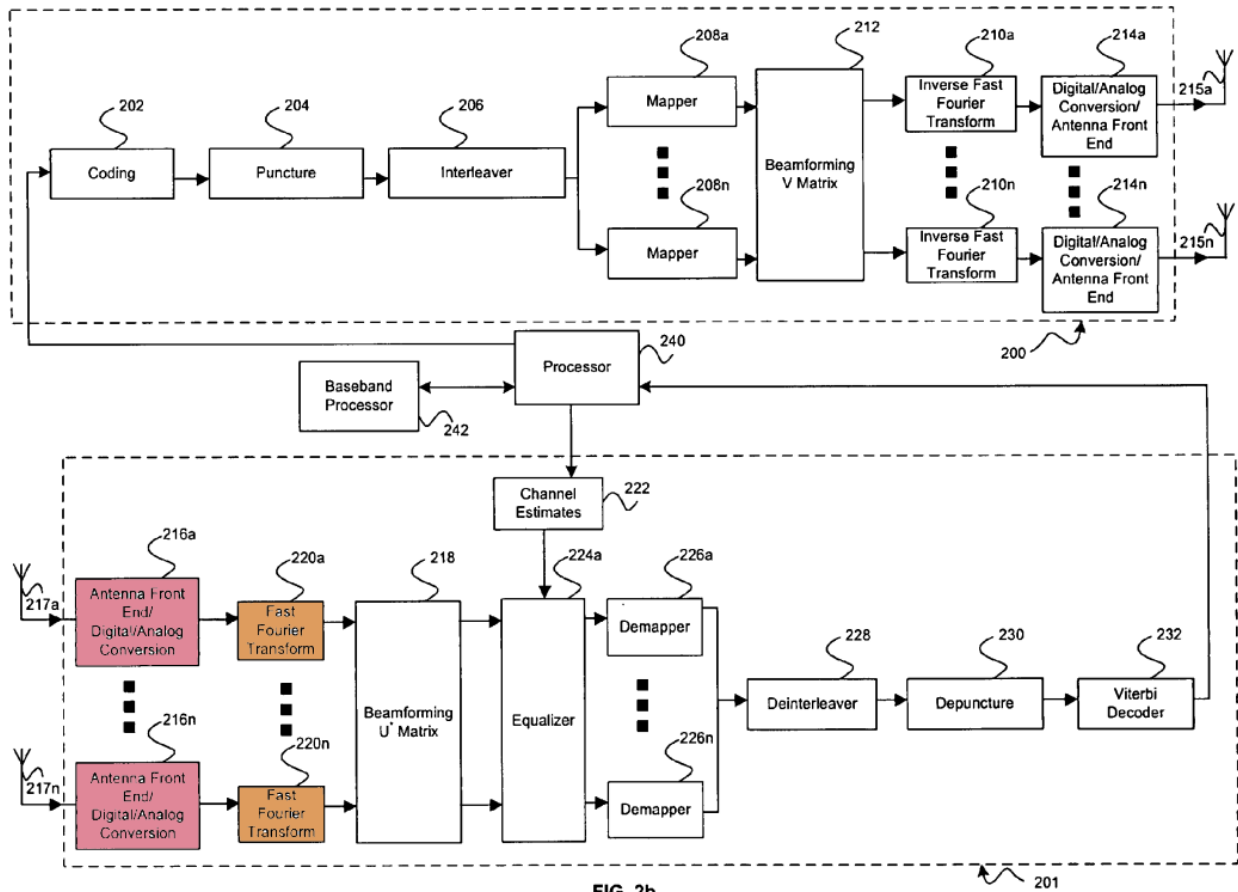


ER Greenfield PPDU (“*Second Packet Type*”)
(Combined Hansen Figure 3a and Excerpt for Figure 6a
as modified by July 2005 WWiSE)

b. “Wireless OFDM Receiver”

The receiver portion 201 of Hansen’s transceiver, illustrated in annotated Figure 2b below⁵, includes antenna front end and analog to digital conversion blocks 216a-n (shaded red), referred to herein as “AFE/ADC blocks”. (DELL-1005, ¶50, *see also*, DELL-1005, ¶15.) Each AFE/ADC block 216 receives analog RF signals via an antenna, converts the RF signal to baseband and generates a digital equivalent of the received analog baseband signal. (DELL-1005, ¶50.) The number of AFE/ADC blocks 216 equals “the number of receiving antenna 117a, ..., 117n at the receiver.” (DELL-1005, ¶50.) A single antenna system would include only a single AFE/ADC block 216. (DELL-1003, ¶108; DELL-1015, 24 (illustrating a receiver for a single antenna system).)

⁵ Figure 2b appears to include a typographical error. It labels block 216 “antenna front end/digital/analog conversion.” Based on the specification (¶50) and general knowledge in the art, a POSITA would have understood this block includes analog/digital conversion not digital/analog conversion.



Hansen, Annotated Figure 2b

The one or more AFE/ADC blocks 216 used to receive the RF signals associated with an incoming “*packet*” are collectively the “*receiver*” for that incoming “*packet*.” (DELL-1003, ¶109, *citing, e.g.,* DELL-1005, ¶39.) Thus, the combination of Hansen and July 2005 WWiSE discloses “*a wireless OFDM communications receiver operable to receive*” PPDU, including the NR green field PPDU (“*first packet type*”) and the ER green field PPDU (“*second packet type*”). (DELL-1003, ¶¶107-109; *see also, §V.B.1 (“wireless OFDM transceiver”).*)

Hansen's AFE/ADC blocks 216 utilize an antenna to receive RF signals over an RF channel. (DELL-1005, ¶¶50, 59 (“in connection with the reception of signals via an RF channel”), 56 (referring to “data received via the RF channel”); *see also*, DELL-1005, ¶31 (describing wireless communication “via an RF channel” by the system), ¶15 (referring to the system of Figure 2b as a “transceiver”).) The systems of both Hansen and July 2005 WWiSE support channels having a bandwidth of 20 MHz and 40 MHz (*See* DELL-1005, ¶¶34-35; DELL-1006, 70:6-7 (Bandwidth parameter indicating either 20 MHz or 40 MHz).) Therefore, the 20 MHz or 40 MHz **bandwidth** (BW) field 494 included in the Signal*-N field of the NR greenfield PPDU and in the Long Signal*-N field of the ER greenfield PPDU “indicate[s] whether the PPDU was transmitted using a **20 MHz RF channel**, or a **40 MHz RF channel**.” (DELL-1005, ¶68; *see also*, DELL-1005, ¶¶67, 87, 97; §§V.A.1, 3.) Transmission over a 20 MHz or 40 MHz channel corresponds to reception over a 20 MHz or 40 MHz channel respectively. (DELL-1003, ¶110.)

The combination of Hansen and July 2005 WWiSE therefore discloses “*a wireless OFDM communications receiver operable to receive, over a wireless communication channel, a first packet type [NR greenfield PPDU] in a first channel bandwidth [e.g., 40 MHz channel]*” [1A] and “*the wireless OFDM communications receiver further operable to receive, over the wireless communications channel, a second packet type [ER greenfield PPDU] in a second*

channel bandwidth [e.g., 20 MHz channel]” [1F]. (DELL-1003, ¶¶107-111.)

Indeed, a POSITA would have understood that transmitting or receiving an ER greenfield PPDU in a 20 MHz channel instead of a 40 MHz channel would provide double the power spectral density, providing better range for the ER communication. (DELL-1003, ¶111.)

The combination of Hansen and July 2005 WWiSE discloses that the same device is operable to receive both the “*first packet type*” [NR greenfield PPDU] and the “*second packet type*” [ER greenfield PPDU]. (DELL-1003, ¶112.) July 2005 WWiSE specifies that ER “capable devices are devices which support the optional Extended Range MCS, **in addition** to the Normal Range (NR) MCS, and the long SIG-N field format.” (DELL-1006, 50:9-10.) The REXT bit in the Signal*-N field in the combination of Hansen and July 2005 WWiSE indicates whether an ER capable device is operating in ER or NR mode. (*See, e.g.*, DELL-1006, 69:29-31, 70:6-7, 50:9-1.) For example, in July 2005 WWiSE “ER frames shall be transmitted with the long SIG-N field format and the REXT bit set to value 1.” (DELL-1006, 50:12-13.) NR frames are sent with the SIG-N field format and the REXT bit set to value 0. (DELL-1003, ¶112.) An ER capable device therefore receives both ER and NR PPDU. Thus, the combination of Hansen and July 2005 WWiSE discloses that a “*transceiver*” (ER capable device) is operable to receive

both the “*first packet type*” (NR greenfield PPDU) and the “*second packet type*” (ER greenfield PPDU). (DELL-1003, ¶112.)

3. “*Packet Type*” Limitations

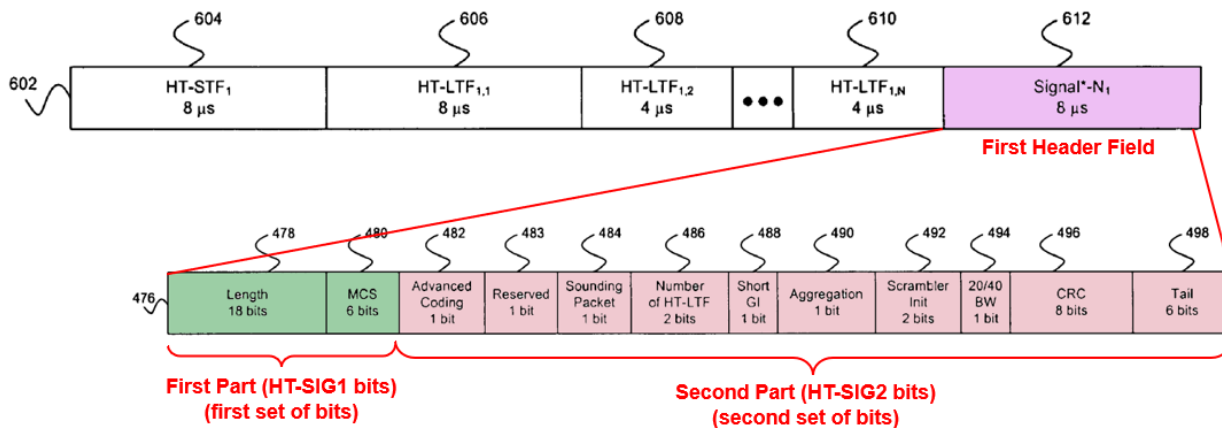
a. “*First Packet Type*”

(i) Content

The combination of Hansen and July 2005 WWiSE discloses the “*first packet type comprising a first header field, wherein the first header field comprises two parts, a first part comprising a first set of header bits of the first header field and a second part comprising a second set of header bits of the first header field*” [1B]. (DELL-1003, ¶¶114-122.)

The training (preamble) and header fields for a single spatial stream 602 of the NR greenfield PPDU⁶ are illustrated in the excerpt from Hansen’s Figure 6a below (top). As shown, the PPDU includes a Signal*-N field (the HT-SIG field of TGn Sync), which Hansen refers to as a “header field.” (See, e.g., DELL-1005, ¶¶67, 20, 97.) Signal*-N carries control information (e.g., MCS field, advanced coding, and 20Mz or 40Mhz bandwidth fields). (DELL-1005, ¶¶67-68.) Signal*-N is therefore “*a first header field*” of the NR green field PPDU (“*first packet type*”). (DELL-1003, ¶¶115-117; DELL-1001, 1:53-56; DELL-1005, ¶59.)

⁶ Hansen’s Figure 6a omits the PPDU data (payload).



Excerpt of Hansen, Figure 6a (top); Figure 4c (bottom)

The Signal*-N header field of the NR greenfield PPDU uses the HT-SIG field from the TGn Sync proposal, shown in Figure 4c above (at bottom). (DELL-1005, ¶¶87, 97 (Signal*-N represented “as described in FIG. 4c”), ¶67 (“FIG. 4c shows an exemplary HT-SIG header field ... in accordance with a TGn Sync proposal”); *see also*, §V.A.3.) The Signal*-N field (prior to coding and modulation) comprises 48 total bits corresponding to 2 transmitted OFDM symbols. (DELL-1005, ¶¶97, 62, 67-68.) The TGn Sync proposal specifies that the first 24 bits of HT-SIG (Signal*-N) correspond to a first transmitted OFDM symbol (HT-SIG1 symbol) and the second 24 bits of the HT-SIG field correspond to the second transmitted OFDM symbol (HT-SIG2 symbol). (See DELL-1012, 133:7-134:2; DELL-1005, ¶67 (HT-SIG is “in accordance” with TGn Sync proposal); §V.A.1.) Thus, Signal*-N (“*first header field*”) of the NR greenfield

PPDU includes “*two parts*”—HT-SIG1 and HT-SIG2. (DELL-1003, ¶¶118-119.)

Prior to coding and modulation at the transmitter and after decoding by the receive chain, the HT-SIG1 part of the Signal*-N field (shaded green above) includes an 18-bit length field 478 and a 6-bit MCS field 480 (referred to collectively as the HT-SIG1 bits). (DELL-1005, ¶¶67-68.) HT-SIG1 is therefore “*a first part*” of the Signal*-N header field “*comprising a first set of header bits of the first header field.*” (DELL-1003, ¶120.)

Prior to coding and modulation at the transmitter and after decoding by the receive chain, the HT-SIG2 part of the Signal*-N field (shaded red above) includes a 1-bit advanced coding field 482, a 1-bit reserved field 483, a 1-bit sounding packet field 484, a 2-bit number of HT-LTF field 486, a 1-bit short GI field, a 1-bit aggregation field 490, a 2-bit scrambler initialization field 492, a 1-bit 20 MHz or 40 MHz bandwidth (BW) field 494, an 8-bit cyclical redundancy check field 496, and a 6-bit tail field 498 (referred to collectively as the HT-SIG2 bits). (DELL-1005, ¶¶67-68.) HT-SIG2 is therefore “*a second part*” of Signal*-N “*comprising a second set of header bits of the first header field.*” (DELL-1003, ¶121.)

Thus, the combination of Hansen and July 2005 WWiSE discloses limitation [1B]. (DELL-1003, ¶¶114-122.)

Because the “*first set of header bits of the first header field*” includes different fields than the “*second set of header bits of the first header field*” as

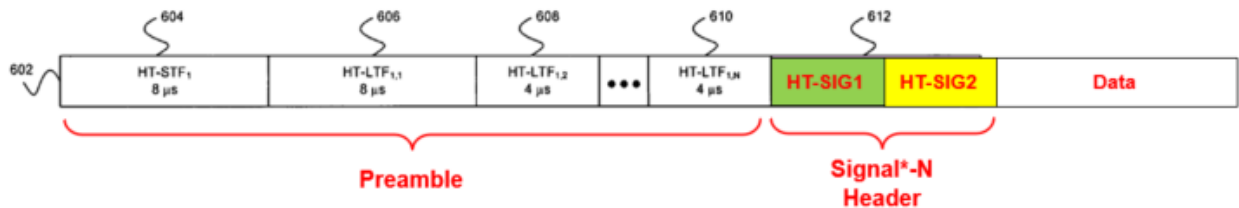
discussed above, the combination of Hansen and July 2005 WWiSE also discloses “the first set of header bits of the first header field [HT-SIG1 bits] is different than the second set of header bits [HT-SIG2 bits] of the first header field” [1C]. (DELL-1003, ¶123.)

(ii) Order of Transmission/Reception

An OFDM transmitter transmits a PPDU over the wireless medium as a sequence of OFDM symbols. (DELL-1006, 58:6-8; *see also*, DELL-1015, 7 (§17.3.1).) An OFDM receiver receives the PPDU over the wireless medium as the same sequence of OFDM symbols. (DELL-1003, ¶124, *citing* DELL-1006, 67:1-3, 68:1-4.) The ordering of OFDM symbols in the NR green field PPDU (“first packet type”) reflects the order the OFDM symbols of the PPDU are transmitted by the transmitter and the order the same OFDM symbols are received by the receiver. (DELL-1003, ¶125.)

Hansen teaches its Signal*-N field, when transmitted, “comprise[s] 2 OFDM symbols.” (DELL-1005, ¶97.) Consistent with Hansen, the TGn Sync proposal sets forth that “HTSIG consists of two OFDM symbols: HTSIG1 and HTSIG2.” (DELL-1012, 133:9; 121:1-2 (Figure 55, mapping HT-SIG header bits to 8μs header field in transmitted PPDU), 133:27 (explaining symbol duration is 4μs); DELL-1005, ¶67 (HT-SIG header field of Figure 4c “in accordance with a TGn Sync proposal”), ¶97 (Signal*-N is “as described in FIG. 4c”).) The TGn Sync

proposal specifies that “HTSIG1 **shall be transmitted first in time.**” (DELL-1012, 133:9-10; DELL-1005, ¶¶67 (HT-SIG header field of Figure 4c “in accordance with a TGn Sync proposal”), ¶¶97 (Signal*-N is “as described in FIG. 4c”).) Thus, in the NR greenfield PPDU, the HT-SIG1 symbol is transmitted and therefore received before the HT-SIG2 symbol. (DELL-1003, ¶¶125-126.) The NR greenfield PPDU illustrated below shows the order the PPDU OFDM symbols are transmitted and received over the wireless medium, with the HT-STF (short training field) OFDM symbol being transmitted first. (DELL-1003, ¶¶126.) The OFDM symbols of the NR greenfield PPDU are received in the same order that they are transmitted, with HT-STF (short training field) being received first. (*Id.*)



NR Greenfield PPDU
(Hansen’s Figure 3a and Excerpt from Figure 6a with Signal*-N symbols)

b. “Second Packet Type”

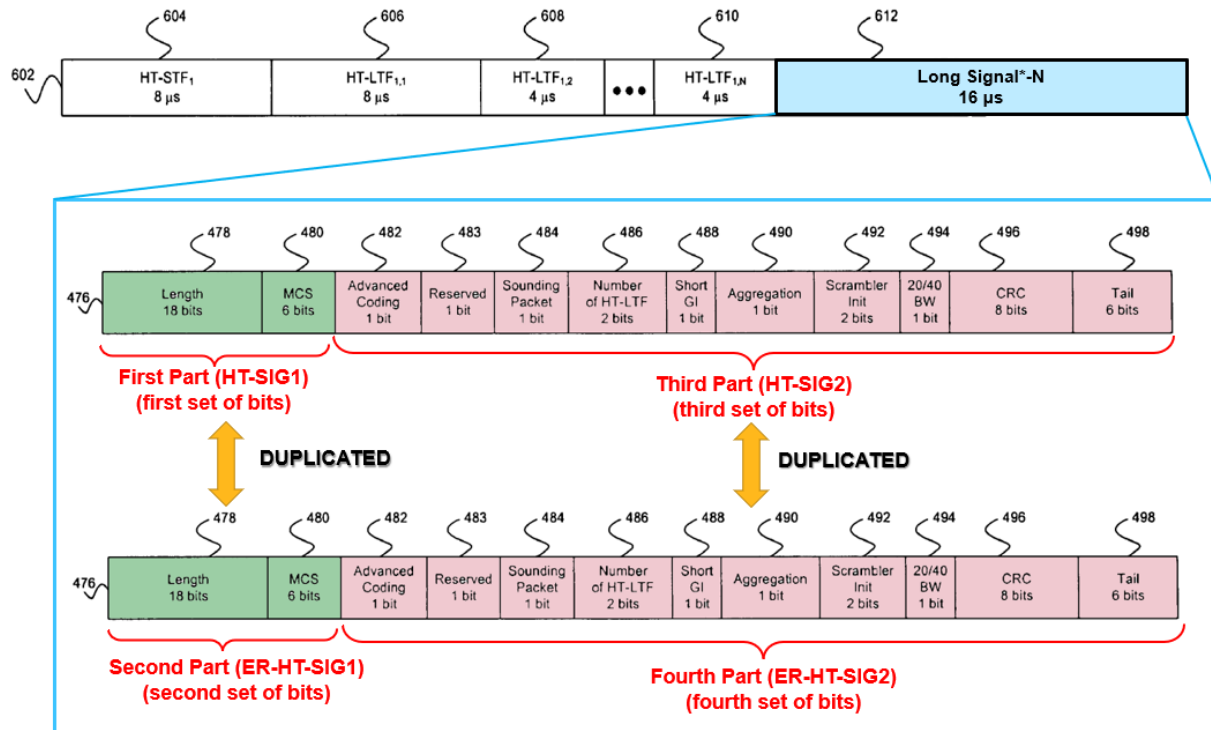
(i) Content

The combination of Hansen and July 2005 WWiSE further discloses a “second packet type comprising a second header field, wherein the second header field comprises four parts, a first part comprising a first set of header bits of the

second header field, a second part comprising a second set of header bits of the second header field, a third part comprising a third set of header bits of the second header field and a fourth part comprising a fourth set of header bits of the second header field” [1G]. (DELL-1003, ¶¶127-134.)

The ER green field PPDU in the combination of Hansen and July 2005 WWiSE includes the “Long Signal*-N” field which repeats each part of Hansen’s Signal*-N (HT-SIG1 and HT-SIG2). (See §V.A.3; DELL-1006, 69:16-18 (“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”), 67:1-69:7 (Figures 007-016, referring to “duplicate SIG-N”), 50:9-10 (referring to header with repeated symbols as the “long SIG-N”).) For the same reasons discussed in §V.B.3.a for Signal*-N, “Long Signal*-N” is a “*second header field*” of the ER green field PPDU (“*second packet type*”). (DELL-1003, ¶128.)

The repetition of the two parts of Signal*-N results in a four-part header having two HT-SIG1 parts (HT-SIG1/ER-HT-SIG1) and two HT-SIG2 parts (HT-SIG2/ER-HT-SIG2), as illustrated in the figure below. (See also, §V.A.3.) Thus, the “Long Signal*-N” (“*second header field*”) of the ER green field PPDU includes “*four parts.*” (DELL-1003, ¶129.)



Prior to coding and modulation at the transmitter and after decoding by the receive chain, the first HT-SIG1 part of Long Signal*-N (shaded green above) includes length and MCS fields. HT-SIG1 is therefore a “*first part*” of Long Signal*-N “*comprising a first set of header bits of the second header field.*” (See DELL-1005, ¶¶67-68; DELL-1003, ¶130.) Prior to coding and modulation at the transmitter and after decoding by the receive chain, the repeated HT-SIG1 part of Long Signal*-N (ER-HT-SIG1; shaded green above) includes the same fields as HT-SIG1. (See DELL-1003, ¶131.) ER-HT-SIG1 is therefore a “*second part*” of Long Signal*-N “*comprising a second set of header bits of the second header field.*” (See DELL-1005, ¶¶67-68; DELL-1006, 69:16-18, 67:1-69:3 (Figures 007,

009, 011, 013, and 015, showing duplicated headers for ER green field operation); DELL-1003, ¶131.)

Prior to coding and modulation by the transmitter and after decoding by the receive chain, the first HT-SIG2 part of Long Signal*-N (shaded red above) includes advanced coding, reserved, sounding packet, number of HT-LTF, short GI, aggregation, scrambler initialization, 20 MHz or 40 MHz BW, cyclical redundancy check, and tail fields. HT-SIG2 is therefore a “*third part*” of Long Signal*-N “*comprising a third set of header bits of the second header field.*” (See DELL-1005, ¶¶67-68; DELL-1003, ¶132.)

Prior to coding and modulation by the transmitter and after decoding by the receive chain, the repeated HT-SIG2 part of the Long Signal*-N field (ER-HT-SIG2; shaded red above) includes the same fields as HT-SIG2. (See DELL-1003, ¶133.) ER-HT-SIG2 is therefore a “*fourth part*” of Long Signal*-N “*comprising a fourth of header bits of the second header field.*” (See DELL-1005, ¶¶67-68; DELL-1006, 69:16-18, 67:1-69:3; DELL-1003, ¶133.)

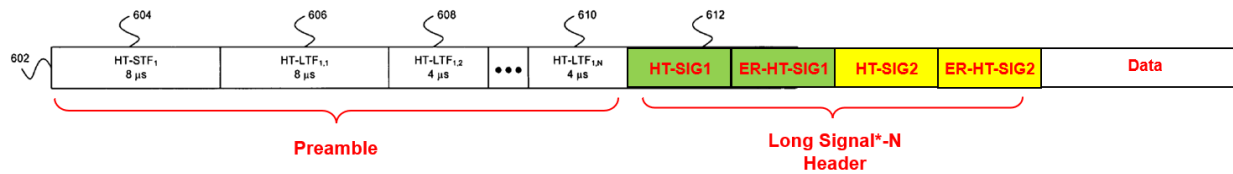
Thus, the combination of Hansen and July 2005 WWiSE discloses limitation [1G]. (DELL-1003, ¶¶127-134.)

Because the “*first set of header bits of the second header field*” encodes the same fields as the “*second set of header bits of the second header field*” and “*the third set of header bits of the second header field*” encodes the same fields as the

“fourth set of header bits of the second header field”, the combination of Hansen and July 2005 WWiSE discloses *“the first set of header bits of the second header field is the same as the second set of header bits of the second header field”* and *“the third set of header bits of the second header field is the same as the fourth set of header bits of the second header field”* [1H]. (DELL-1003, ¶135.)

(ii) Order of Transmission/Reception

As discussed in §V.B.3.a, the Signal*-N field comprises “comprise[s] 2 OFDM symbols”, HT-SIG1 symbol and HT-SIG2 symbol. (DELL-1005, ¶97; DELL-1012, 133:9.) Repeating the two-part Signal*-N, as taught by July 2005 WWiSE, results in 4 OFDM symbols in the Long Signal*-N header field—two HT-SIG1 symbols and two HT-SIG2 symbols. (DELL-1003, ¶159; see DELL-1006, 69:16-18.) Neither Hansen nor July 2005 WWiSE explicitly discloses the order of transmission or generation for the four OFDM symbols corresponding to the Long Signal*-N header bits. However, it would have been obvious to a POSITA that the Long Signal*-N header OFDM symbols are generated and transmitted in the following order: HT-SIG1, ER-HT-SIG1, HT-SIG2, ER-HT-SIG2, as illustrated in the figure below. (DELL-1003, ¶¶137-145.)



ER Greenfield PPDU

First, the transmission ordering of HT-SIG1, ER-HT-SIG1, HT-SIG2, and ER-HT-SIG2 would have been obvious to try. (DELL-1003, ¶¶138-141.) Because TGn Sync requires that “HTSIG1 shall be transmitted first in time” (DELL-1012, 133:9-10), a POSITA would have understood that only two alternatives exist in the combination of Hansen and July 2005 WWiSE for the order of OFDM symbols associated with the four parts of the Long Signal*-N header field: (1) HT-SIG1, ER-HT-SIG1, HT-SIG2, and ER-HT-SIG2 or (2) HT-SIG1, HT-SIG2, ER-HT-SIG1, and ER-HT-SIG2. *See KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007); DELL-1003, ¶¶138-141.

A POSITA would have had a reasonable expectation of success in pursuing both OFDM symbol ordering alternatives. (DELL-1003, ¶¶139-141.) First, both options merely involve copying (repeating) bit strings during the process of generating OFDM symbols for transmission. (DELL-1003, ¶139.) Such techniques for repetition coding of a message part associated with an OFDM symbol to create two repeated OFDM symbols would have been known to a POSITA. (*Id.*) In fact, the G.9960 standard, which is admitted by the ’459 patent to be prior art, discloses

repetition coding for header bits. (DELL-1018, 51:1331-1358; DELL-1001, 1:56-58 (admitting G.9960 “should be familiar to those skilled in the art”).)

Additionally, a POSITA would have understood that the order of Long Signal*-N header parts (and resulting symbols) in a PPDU would be specified in documentation (such as an industry standard) so that a receiver is able to interpret received data. (DELL-1003, ¶140, *citing* DELL-1006, 67:1-69:17 (illustrating PPDU); DELL-1012, 121:1-2 (Figure 55, illustrating PPDU format); DELL-1015, 33 (Figure 122; illustrating PPDU transmit procedure).) Therefore, a POSITA would have had a reasonable expectation of success in implementing both ordering alternatives in a wireless system. (DELL-1003, ¶¶139-141.)

For these reasons, trying these two alternatives for ordering two repeated OFDM symbols in the Long Signal*-N header field would have led a POSITA to anticipated success with either alternative. (DELL-1003, ¶141.) Accordingly, an ER green field PPDU having the symbol order of HT-SIG1, ER-HT-SIG1, HT-SIG2, ER-HT-SIG2 for the Long Signal*-N field is “the product **not of innovation** but of ordinary skill and **common sense**.” *See Perfect Web Techs., Inc. v. InfoUSA, Inc.*, 587 F.3d 1324, 1331 (Fed. Cir. 2004), *quoting KSR*, 550 U.S. at 421.

Moreover, a POSITA is an individual with experience with wireless communication protocols. (*See* §IV.A.) The simple concept of repeating parts of a

header field one after another would not have required the POSITA to explore new technologies or approaches. *See Id.*

Second, July 2005 WWiSE suggests the above ordering. As discussed in §V.B.2.a, TGn Syn requires that “HTSIG1 shall be transmitted first in time.” (*See* DELL-1012, 133:9-10.) July 2005 WWiSE teaches repeating a header symbol, placing the repeated (duplicated) symbol immediately after the original symbol. (DELL-1006, 69:16-18, 67:1-69:17 (Figures 007, 009, 011, 013, and 15 showing green field operation).) Based on this suggestion, a POSITA would have been motivated to duplicate the parts of Long Signal*-N on a part-by-part (symbol-by-symbol) basis, resulting in the ordering HT-SIG1, ER-HT-SIG1, HT-SIG2, and ER-HT-SIG2. (DELL-1003, ¶142.)

Third, a POSITA would have been motivated to pursue the above ordering to improve efficiency in both the reception chain and transmission chain. (DELL-1003, ¶¶143-145.) When using repeated symbols, the receive chain demodulates both symbols, combines the symbols, and decodes the combined symbol. (DELL-1003, ¶143.) For the transmission order HT-SIG1, ER-HT-SIG1, HT-SIG2, ER-HT-SIG2, the first symbol (HT-SIG1) is received, demodulated, and stored in a buffer at the receiver. The second HT-SIG1 symbol (ER-HT-SIG1) is then received, demodulated and combined with HT-SIG1 from the buffer and the combined demodulated symbol is decoded. (*Id.*) The same process is repeated for

HT-SIG2/ER-HT-SIG2. However, if the transmission order was HT-SIG1, HT-SIG2, ER-HT-SIG1, ER-HT-SIG2, the receive chain would need to buffer demodulated HT-SIG1 **and** demodulated HT-SIG2 before the ER-HT-SIG1 symbol is received, requiring an extra buffer to store both demodulated HT-SIG1 and HT-SIG2, before the demodulated symbols could be combined. (DELL-1003, ¶144.)

A POSITA would have understood that generating the repeated header fields for ER packets could be efficiently implemented by merely reading the HT-SIG1 and HT-SIG2 fields out of a buffer twice, instead of re-generating them from scratch. (DELL-1003, ¶145.) A POSITA would have further understood that generating HT-SIG1, repeating HT-SIG1 as ER-HT-SIG1, then generating HT-SIG2, and repeating HT-SIG2 as ER-HT-SIG2 would only require a buffer large enough to hold one symbol's worth of data, whereas generating HT-SIG1 and HT-SIG2 together, and then duplicating both as ER-HT-SIG1 and ER-HT-SIG2 would require a buffer large enough to hold two symbols' worth of data, thereby reducing efficiency. (*Id.*)

Therefore, it would have been obvious to a POSITA that the Long Signal*-N header OFDM symbols are transmitted in the following order: HT-SIG1, ER-HT-SIG1, HT-SIG2, ER-HT-SIG2. (DELL-1003, ¶¶136-146.)

4. “Demodulator” Limitations

Claim 1 recites the following limitations directed to “*a demodulator*”:

[1D] *a demodulator operable to demodulate a first OFDM symbol followed by a second OFDM symbol,*

[1E] *wherein the first OFDM symbol is used to receive the first part of the first header field and the second OFDM symbol is used to receive the second part of the first header field,*

[1I] *the demodulator further operable to demodulate a first OFDM symbol followed by a second OFDM symbol followed by a third OFDM symbol followed by a fourth OFDM symbol,*

[1J] *wherein the first OFDM symbol is used to receive the first part of the second header field, the second OFDM symbol is used to receive the second part of the second header field, the third OFDM symbol is used to receive the third part of the second header field, the fourth OFDM symbol is used to receive the fourth part of the second header field,*

The combination of Hansen and July 2005 WWiSE discloses “*a demodulator operable to demodulate*” the OFDM symbols associated with the “*first header field*” and the OFDM symbols associated with the “*second header field*.” (DELL-1003, ¶¶148-158.)

In Hansen’s transceiver, illustrated in annotated Figure 2b below, FFT block(s) 220 (shaded orange) receive signals from the AFE/ADC block 216. July

2005 WWiSE teaches that header field is transmitted simultaneously from all TX antennas in all modes. (See DELL-1006, 70:18-21 (“The SIG-N MIMO OFDM symbol is transmitted simultaneously from all TX antennas in all modes”).) The TGn Sync proposal similarly teaches that the header field is either transmitted by a single antenna or by all antennas in parallel. (See DELL-1012, 121:24-122:2; DELL-1005, ¶HT-SIG header field of Figure 4c is “in accordance with a TGn Sync proposal”); ¶97 (Signal*-N is “represented as described in FIG. 4c.”)) Accordingly, each antenna and AFE/ADC block receives the same signal associated with the header and passes the same header signal to the FFT blocks 220. (DELL-1003, ¶149.)

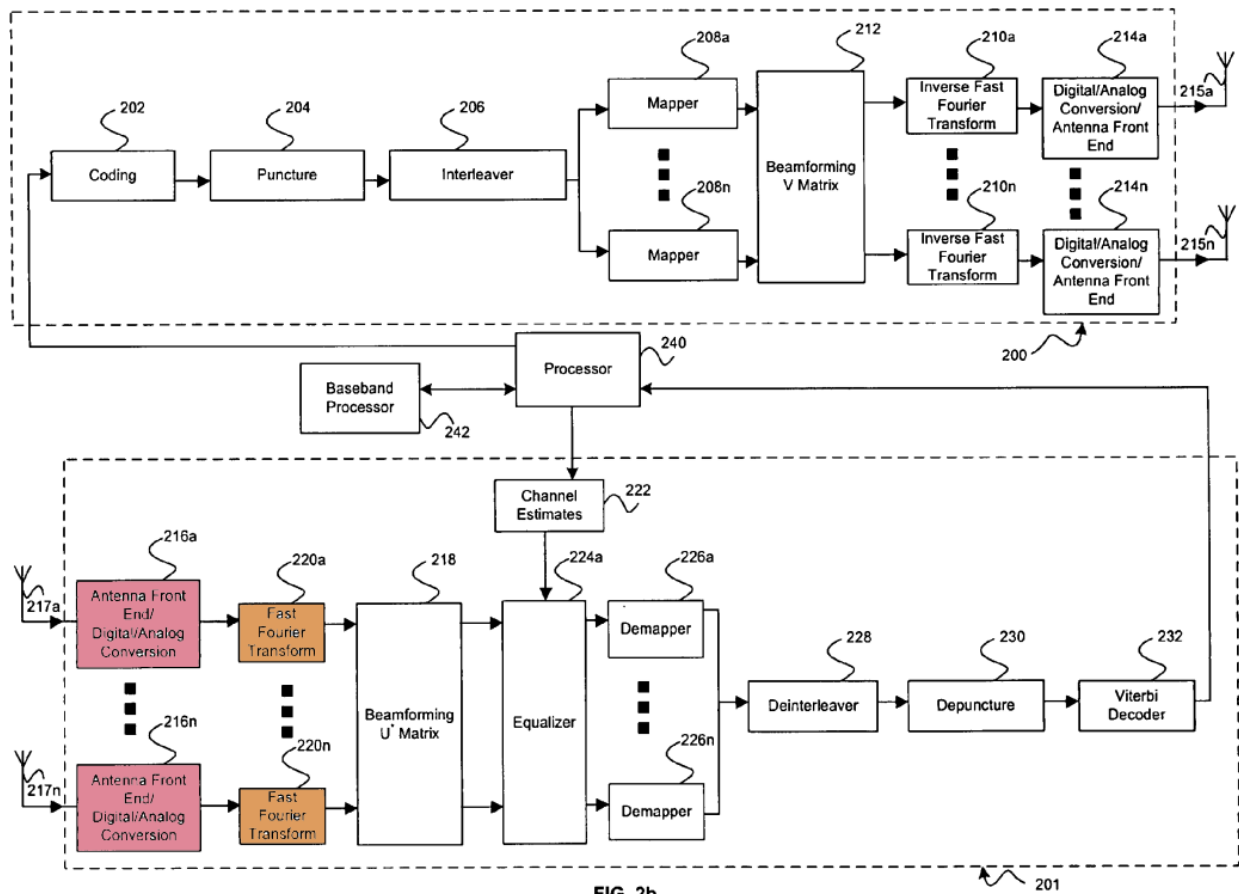


FIG. 2b

Hansen, Annotated Figure 2b

An FFT block 220 “appl[ies] an n-point FFT technique” to “**demodulat[e]** the signal by a plurality of carrier signals based on the n sub-band frequencies utilized in the transmitter 200.” (DELL-1005, ¶51.) The demodulated signals are “mathematically integrated over one sub band frequency period” by an FFT block to extract the OFDM symbol. (DELL-1005, ¶51.) Because each FFT block 220 receives the same header signal, each FFT block produces the same OFDM symbols associated with the header. (DELL-1003, ¶150.)

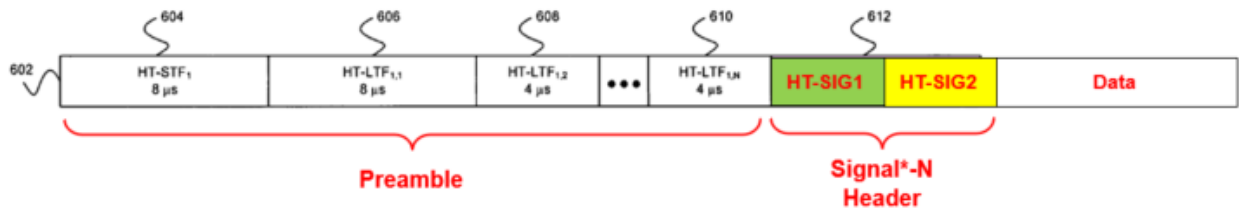
FFT block 220 is therefore a “*demodulator*” operable to demodulate OFDM symbols. (DELL-1003, ¶¶149-151.) As highlighted by Figure 2b above, the “*demodulator*” (shaded orange) is a separate component from the “*wireless OFDM receiver*.” (DELL-1003, ¶151.)

a. “*First Packet Type*” - Order of Symbol Demodulation

The combination of Hansen and July 2005 WWiSE discloses the “*demodulator operable to demodulate a first OFDM symbol followed by a second OFDM symbol*” [1D] where “*the first OFDM symbol is used to receive the first part of the first header field and the second OFDM symbol is used to receive the second part of the first header field*” [1E]. (DELL-1003, ¶¶152-154.)

The symbols of the NR greenfield PPDU, illustrated below, are received and demodulated in the order of transmission. (DELL-1003, ¶153.) As discussed above, each FFT receives the same signal corresponding to the transmitted Signal*-N header field. (See, DELL-1006, 70:18-21 (“The SIG-N MIMO OFDM symbol is transmitted simultaneously from all TX antennas in all modes”); DELL-1012, 121:24-122:2; DELL-1005, ¶HT-SIG header field of Figure 4c is “in accordance with a TGn Sync proposal”); ¶97 (Signal*-N is “represented as described in FIG. 4c.”)) Because HT-SIG1 is transmitted first, it is received and demodulated first, followed by HT-SIG2. The combination of Hansen and July 2005 WWiSE therefore discloses a “*demodulator [FFT] operable to demodulate a*

first OFDM symbol [HT-SIG1 symbol] followed by a second OFDM symbol [HT-SIG2 symbol]” [1D]. (DELL-1003, ¶153.)



NR Greenfield PPDU (Hansen’s Figures 3a, 6a, and 4c)

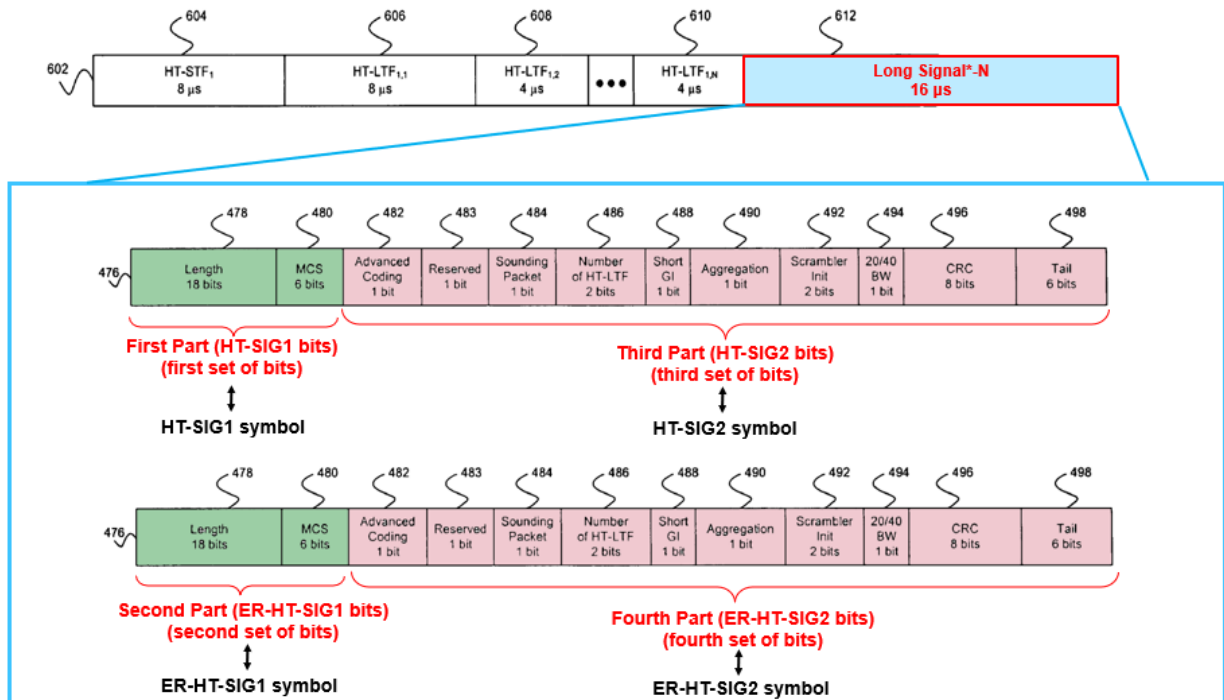
As I discussed in §V.B.3.a, Signal*-N consists of two symbols: HT-SIG1 and HT-SIG2. Because the HT-SIG1 bits are associated with the HT-SIG1 symbol and the HT-SIG2 bits are associated with the HT-SIG2 symbol, in the combination of Hansen and July 2005 WWiSE a “*first OFDM symbol [HT-SIG1 symbol] is used to receive the first part of the first header field [HT-SIG1 bits]*” and a “*second OFDM symbol [HT-SIG2 symbol] is used to receive the second part of the first header field*” [1E]. (DELL-1003, ¶154; DELL-1012, 133:9, 134:1-2; DELL-1005, ¶67 (HT-SIG header field of Figure 4c is “in accordance with a TGn Sync proposal”); ¶97 (Signal*-N is “represented as described in FIG. 4c.”); *See also*, §IV.B.3.a.)

b. “Second Packet Type” - Order of Symbol Demodulation

The combination of Hansen and July 2005 WWiSE renders obvious the limitation that the “*demodulator [is] further operable to demodulate a first OFDM*

symbol followed by a second OFDM symbol followed by a third OFDM symbol followed by a fourth OFDM symbol” [1I] where “the first OFDM symbol is used to receive the first part of the second header field, the second OFDM symbol is used to receive the second part of the second header field, the third OFDM symbol is used to receive the third part of the second header field, the fourth OFDM symbol is used to receive the fourth part of the second header field” [1J]. (DELL-1003, ¶¶155-158.)

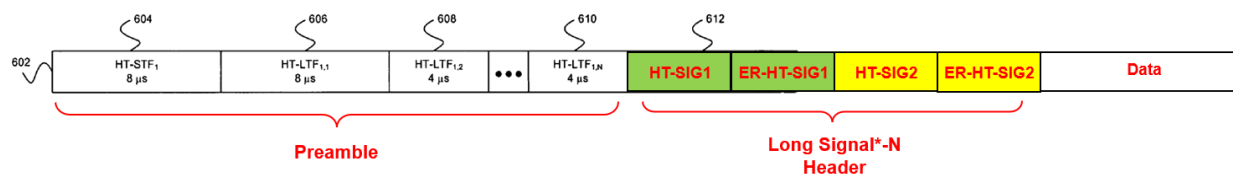
Each of the four symbols in the Long Signal*-N header field corresponds to a set of bits as illustrated below: HT-SIG1 symbol corresponds to HT-SIG1 bits, ER-HT-SIG1 symbol corresponds to ER-HT-SIG1 bits, HT-SIG2 symbol corresponds to HT-SIG2 bits, ER-HT-SIG2 symbol corresponds to ER-HT-SIG2 bits. (See §V.B.3.b.)



Thus, in the combination of Hansen and July 2005 WWiSE, a “*first OFDM symbol* [HT-SIG1 symbol] is used to receive the first part of the second header field [HT-SIG1 bits]”, a “*second OFDM symbol* [ER-HT-SIG2 symbol] is used to receive the second part of the second header field [ER-HT-SIG1 bits]”, a “*third OFDM symbol* [HT-SIG2 symbol] is used to receive the third part of the second header field [HT-SIG2 bits]”, and a “*fourth OFDM symbol* [ER-HT-SIG2 symbol] is used to receive the fourth part of the second header field [ER-HT-SIG2 bits]” [1J]. (DELL-1003, ¶¶155-157.)

As discussed in §V.B.3.b above, the combination of Hansen and July 2005 WWiSE renders obvious the transmission and reception order for the Long Signal*-N header (HT-SIG1, ER-HT-SIG1, HT-SIG2, ER-HT-SIG2) in the ER

greenfield PPDU, illustrated in the following figure. And as discussed in §V.B.4 above, each FFT receives the same signal corresponding to the transmitted Long Signal*-N header field. (See, DELL-1006, 70:18-21 (“The SIG-N MIMO OFDM symbol is transmitted simultaneously from all TX antennas in all modes”); DELL-1012, 121:24-122:2; DELL-1005, ¶67 (HT-SIG header field of Figure 4c is “in accordance with a TGn Sync proposal”); ¶97 (Signal*-N is “represented as described in FIG. 4c.”).) Because symbols of a PPDU are received and demodulated in the order of transmission, the combination of Hansen and July 2005 WWiSE renders obvious the limitation “*the demodulator [FFT] further operable to demodulate a first OFDM symbol [HT-SIG1 symbol] followed by a second OFDM symbol [ER-HT-SIG1 symbol] followed by a third OFDM symbol [HT-SIG2 symbol] followed by a fourth OFDM symbol [ER-HT-SIG2 symbol]*” [1I]. (DELL-1003, ¶158.)



ER Greenfield PPDU

c. “Received in a Different Order” Limitations [1K]/[1L]

The combination of Hansen and July 2005 WWiSE discloses “*the second set of header bits of the second header field received using the second OFDM symbol*

are received in a different order than the first set of header bits of the second header field received using the first OFDM symbol” [1K] and “the fourth set of header bits of the second header field received using the fourth OFDM symbol are received in a different order than the third set of header bits of the second header field received using the third OFDM symbol” [1L]. (DELL-1003, ¶¶159-164.)

Outside of the claims, the ’459 patent does not mention or describe the **reception** of header bits of one symbol in a different order than the same header bits repeated in a different symbol. At most, the ’459 patent teaches that “the header bits are **demodulated** from the D OFDM symbols in the same order or in a **different order**” which indicates the header bits were received on different OFDM subcarriers. (DELL-1001, 9:44-46.)

July 2005 WWiSE describes an OFDM subcarrier frequency premutation for the repeated ER-SIG-N. Specifically, July 2005 WWiSE explains that the “frequency domain MIMO-OFDM symbol ER-SIG-N is derived from MIMO-OFDM symbol SIG-N by applying the following permutation on the subcarrier indices (as described in subclause 20.3.2.4) of the OFDM data symbols composing SIG-N:

- For 20Mhz data transmissions: With SIG-N=(0, s(1), s(2) ..., s(28), 0, ..., 0, s(-28), s(-27), ..., s(-1)),

ER-SIG-N is specified as $\text{ER-SIG-N}=(0, s(-28), s(-27), \dots, s(-1), 0, \dots, 0, s(1), s(2) \dots, s(28))$;

- For 40Mhz data transmissions: With $\text{SIG-N}=(0, 0, 0, s(3), s(4) \dots, s(58), 0, \dots, 0, s(-58), s(-57), \dots, s(-3), 0, 0)$,
ER-SIG-N is specified as $\text{ER-SIG-N}=(0, 0, 0, s(-58), s(-57), \dots, s(-3), 0, \dots, 0, s(3), s(2) \dots, s(58), 0, 0)$.”

(DELL-1006, 69.)

Because these subcarriers are used for transmission of the OFDM symbol, the same subcarriers are used in the reception of the OFDM symbol. (DELL-1003, ¶162.) Therefore, consistent with the discussion of transmission, the following permutation exists on the subcarrier indices of the received OFDM symbols for ER-HT-SIG1 and ER-HT-SIG2 in the combination of Hansen and July 2005 WWiSE:

- For 20Mhz data reception: With $\text{SIG-N}=(0, s(1), s(2) \dots, s(28), 0, \dots, 0, s(-28), s(-27), \dots, s(-1))$,
ER-SIG-N is specified as $\text{ER-SIG-N}=(0, s(-28), s(-27), \dots, s(-1), 0, \dots, 0, s(1), s(2) \dots, s(28))$;
- For 40Mhz data reception: With $\text{SIG-N}=(0, 0, 0, s(3), s(4) \dots, s(58), 0, \dots, 0, s(-58), s(-57), \dots, s(-3), 0, 0)$,
ER-SIG-N is specified as $\text{ER-SIG-N}=(0, 0, 0, s(-58), s(-57), \dots, s(-3), 0, \dots, 0, s(3), s(2) \dots, s(58), 0, 0)$.

(*Id.*)

As specified in July 2005 WWiSE, for 20 MHz transmission and reception, the bits mapped to subcarrier $s(1)$ for SIG-N are mapped to subcarrier $s(-28)$ for ER-SIG-N, the bits mapped to subcarrier $s(2)$ for SIG-N are mapped to subcarrier $s(-27)$, and so on. A similar permutation is applied to the 40MHz transmission and reception. A POSITA would understand that applying July WWiSE's frequency permutation to the repeated symbols (ER-HT-SIG1 and ER-HT-SIG2) but not to the original HT-SIG1 and HT-SIG2 symbols would cause the modulated bits associated with the repeated symbols to be output from the FFT (the demodulator) in a different order than their non-repeated counterparts, consistent with the '459 patent's disclosures. (DELL-1003, ¶163; *see also*, DELL-1001, 9:44-46.)

The combination of Hansen and July 2005 WWiSE therefore discloses “*the second set of header bits of the second header field received using the second OFDM symbol are received in a different order than the first set of header bits of the second header field transmitted using the first OFDM symbol*” [1K] and “*the fourth set of header bits of the second header field received using the fourth OFDM symbol are received in a different order than the third set of header bits of the second header field transmitted using the third OFDM symbol*” [1L], in the same manner and to the same extent as the sole embodiment described in the specification relating to different ordering. (DELL-1003, ¶¶159-164.)

d. “*First channel bandwidth is at least two times wider than the second channel bandwidth*” [1M]

The combination of Hansen and July 2005 WWiSE discloses or at least suggests “*the first channel bandwidth is at least two times wider than the second channel bandwidth*” [1M]. (DELL-1003, ¶¶165-167.) As discussed in §V.B.2.b, Hansen’s transceiver utilizes “20 MHz channels, with an optional utilization of 40 RF MHz channels” for transmission of PPDU and indicates the channel bandwidth used through the 20 MHz or 40Mz bandwidth field of the Signal*-N header. (See DELL-1005, ¶¶34-35, 67-68, 78, 97.) A 40 MHz bandwidth “*is at least two times wider*” than the 20 MHz bandwidth. (DELL-1003, ¶165.)

An ER capable device that is also a 40 MHz capable device is operable to transmit and receive both ER green field PPDU and NR green field PPDU in the combination of Hansen and July 2005 WWiSE. (See DELL-1006, 50:9-10; §IV.A.2-3.) An ER capable device determines whether to transmit on the 20 MHz channel or the 40 MHz channel depending on the needed transmission range and the nature of the receiving device. A POSITA would have been motivated to transmit and receive the NR green field PPDU (“*first packet type*”) on the 40 MHz bandwidth to use the largest bandwidth for the highest throughput. This reflects the well understood desire of individuals for maximum communication speed during standard (normal) communication. (DELL-1003, ¶166.) A POSITA would have

also understood, however, that extending range often involves using lower throughput methods, including narrower channels. (*Id.*) A POSITA would therefore have been motivated to transmit and receive the ER green field PPDU (“*second packet type*”) on the 20 MHz bandwidth because doing so would have allocated the available transmit power to a narrower frequency band, thereby increasing transmit power spectral density, thereby maximizing range. (*Id.*)

Thus, the combination of Hansen and July 2005 WWiSE discloses or at least suggests “*the first channel bandwidth is at least two times wider than the second channel bandwidth*” [1M]. (DELL-1003, ¶¶165-167.)

C. Independent Claim 9

Claim 9 is substantially the same as claim 1 with the primary difference being that claim 1 is recited as a system claim whereas claim 9 is recited as a method claim. Hansen “relate[s] to a method and system for compromise greenfield preambles for 802.11n.” (See DELL-1005, ¶7, claim 1.) For this reason and the reasons discussed in §V.B.1, combination of Hansen and July 2005 WWiSE discloses a “*method of operating a wireless OFDM (Orthogonal Frequency Division Multiplexing) transceiver*” [9P]. (DELL-1003, ¶169.)

Limitations [9B]-[9C], [9E], [9H], [9I], [9K], [9L], and [9M] are identical to limitations [1B]-[1C], [1E], [1H], [1I], [1K], [1L], and [1M]. Accordingly, for the reasons discussed in sections listed in the table below, the combination of Hansen

and July 2005 WWiSE renders limitations [9B]-[9C], [9E], [9H], [9I], [9K], [9L], and [9M] obvious.

For the “*wireless OFDM communications receiver*” limitations, limitations [9A] and [9F] recite “*receiving, by the wireless OFDM communications receiver*” whereas limitations [1A] and [1F] recite the “*wireless OFDM receiver [] operable to receive.*” The difference between the limitations is immaterial because as I explained in §V.B.2, the “*wireless OFDM communication receiver*” of the combination of Hansen and July 2005 WWiSE both “*receives*” and “*is operable to receive*” the first and second packet types. The combination of Hansen and July 2005 WWiSE therefore discloses limitations [9A] and [9F] for the same reasons I discussed in §V.B.2. (DELL-1003, ¶171.)

For the “*demodulator*” limitations, limitations [9D] and [9I] recite “*demodulating, by demodulator, ...*” whereas limitations [1D] and [1I] recite a “*demodulator operable to [] demodulate.*” The difference between the limitations is immaterial because as I explained in §V.B.4, the “*demodulator*” of the combination of Hansen and July 2005 WWiSE both “*demodulat[es]*” and “*is operable to demodulate*” the OFDM symbols in the order recited. The combination of Hansen and July 2005 WWiSE therefore renders limitations [9D] and [9I] obvious for the same reasons I discussed in §V.B.4. (DELL-1003, ¶172.)

Claim 9	Section
[9A] receiving, by a wireless OFDM communications receiver ...	§V.B.2
[9B] the first packet type comprising a first header field, ...	§V.B.3.a
[9C] wherein the first set of header bits of the first header field is different ...	§V.B.3.a
[9D] demodulating, by a demodulator, a first OFDM symbol ...	§V.B.4, §V.B.4.a
[9E] wherein the first OFDM symbol is used to receive ...	§V.B.4.a
[9F] receiving, by the wireless OFDM communications receiver, ...	§V.B.2
[9G] the second packet type comprising a second header field, ...	§V.B.3.b
[9H] wherein the first set of header bits of the second header field is the same ...	§V.B.3.b
[9I] and demodulating, by the demodulator, a first OFDM symbol ...	§V.B.4, §V.B.4.b
[9J] wherein the first OFDM symbol is used to receive ...	§V.B.4.b
[9K] wherein the second set of header bits of the second header field received using the second OFDM symbol are received in a different order ...	§V.B.4.c
[9L] wherein the fourth set of header bits of the second header field received using the fourth OFDM symbol are received ...	§V.B.4.c
[9M] wherein the first channel bandwidth is at least two times wider than the second channel bandwidth.	§V.B.4.d

D. Dependent Claims

1. Claims 2, 3, 10, 11

Claims 2 and 10 recite the intended result that “*reception of the same header bits in the second OFDM symbol provides diversity to increase a likelihood of correctly receiving header information of the second packet type*” and claims 3 and 11 recite the intended result that “*reception of the same header bits in the fourth OFDM symbol provides diversity to increase a likelihood of correctly receiving header information of the second packet type.*” The wherein clauses of claims 2, 3, 10, and 11 should not be afforded any patentable weight because each merely recites the intended result of the recited function. *See, e.g., Hoffer v. Microsoft Corp.*, 405 F.3d 1326, 1329 (Fed. Cir. 2005). For this reason, claims 2, 3, 10, and 11 are obvious for the same reasons as independent claims 1 and 9.

The combination of Hansen and July 2005 WWiSE also discloses the subject matter of these claims. (DELL-1003, ¶174-177.) Diversity is a common technique that improves performance over fading channels by ensuring information symbols pass through multiple signal paths, each of which fades independently. (*See* DELL-1024, 59; *see also*, DELL-1025, 130-131; DELL-1003, ¶196.) This technique “mak[es] sure that reliable communication is possible as long as one of the paths is strong.” (DELL-1024, 59; *see also*, DELL-1025, 130-131.) Diversity can be achieved over time (through channel coding or interleaving), over

frequency (if the channel is frequency-selective), or over space (by using multiple transmit and/or receive antennas that are spaced sufficiently apart). (*See Id.*) A simple mechanism for achieving time diversity uses repetition coding—repeating the same bits in multiple symbols. (DELL-1024, 59; DELL-1003, ¶174.)

As explained in §V.A.3, the ER greenfield PPDU of the combination of Hansen and July 2005 WWiSE repeats the HT-SIG1 and HT-SIG2 parts of the Signal*-N field, providing temporal diversity, thereby increasing the likelihood of correctly receiving the repeated header information. (DELL-1003, ¶197.) The ER greenfield PPDU further applies a frequency permutation to the repeated parts of Signal-N field (ER-HT-SIG1 and ER-HT-SIG2) providing frequency diversity and increasing the likelihood of correctly receiving the repeated header information. (DELL-1003, ¶175, *citing* DELL-1030, 21.)

Because the combination of Hansen and July 2005 WWiSE provides HT-SIG1 header bits corresponding to the first OFDM symbol (HT-SIG1 symbol) and repeated HT-SIG1 header bits (ER-HT-SIG1 bits) correspond to the second OFDM symbol (ER-HT-SIG1 symbol) and a frequency permutation is applied to the ER-HT-SIG1 (second) OFDM symbol, the combination of Hansen and July 2005 WWiSE provides “*the reception of the same header bits in the second OFDM symbol provides diversity to increase a likelihood of correctly receiving header information of the second packet type*” [2]/[10]. (DELL-1003, ¶¶174-176.)

Because the combination of Hansen and July 2005 WWiSE provides HT-SIG2 header bits corresponding to the third OFDM symbol (HT-SIG1 symbol) and repeated HT-SIG2 header bits (ER-HT-SIG2 bits) correspond to the fourth OFDM symbol (ER-HT-SIG2 symbol) and a frequency permutation is applied to the ER-HT-SIG2 (fourth) OFDM symbol, the combination of Hansen and July 2005 WWiSE provides “*the reception of the same header bits in the fourth OFDM symbol provides diversity to increase a likelihood of correctly receiving header information of the second packet type*” [3]/[11]. (DELL-1003, ¶¶174-175, 177.)

2. Claims 5, 13

Hansen describes a “system and method for compromise greenfield preambles for **802.11n**.” (DELL-1005, ¶11; *see also, e.g.*, DELL-1005, ¶¶27, 29-32.) July 2005 WWiSE likewise describes a proposed enhancement to existing IEEE 802.11 Wi-Fi standards, for incorporation into the 802.11n standard. (*See, e.g.*, DELL-1005, ¶¶9, 33; DELL-1006, 1.) Hansen’s wireless transceiver further supports mixed mode access for interoperating with legacy devices that only support prior 802.11 standards such as 802.11a. (*See, e.g.*, DELL-1005, ¶¶9, 32, 41, 61-62, 66, 111-112.) Thus, the combination of Hansen and July 2005 WWiSE discloses that “*the wireless transceiver supports one or more wireless standards*” [5]/[13]. (DELL-1003, ¶179.)

3. Claims 7 and 8

The combination of Hansen and July 2005 WWiSE provides “*the first header field indicates the type of packet*” [7] and “*the second header field indicates the type of packet*” [8]. (DELL-1003, ¶¶181-184.)

In the combination of Hansen and July 2005 WWiSE, the REXT field in SIGNAL*-N indicates whether the packet is an NR greenfield-type PPDU or an ER greenfield-type PPDU. (See DELL-1006, 69-70.) The REXT field is present in Signal*-N field in the combination of Hansen and July 2005 WWiSE and therefore is included in both the “*first header field*” (Signal*-N) and “*second header field*” (Long Signal*-N). (See §V.A.3; §V.B.3.a-b.)

The “sounding packet field” in the Signal*-N header field also “indicate[s] whether the corresponding PSDU may be utilized for closed loop calibration between a transmitter and a receiver.” (DELL-1005, ¶68.) Thus, this sub-field, which is included in both the “*first header field*” and “*second header field*,” indicates whether the packet is a sounding packet. (See §V.B.3.a-b; DELL-1005, ¶¶67-68.)

The “*first header field*” and the “*second header field*” likewise each include information describing the modulation and coding schemes to be used for the PPDU’s data payload (the 6-bit “MCS” field), the number of HT-LTF symbols that the PPDU will include (the 2-bit “Number of HT-LTF” field, which also signals

the number of spatial streams that will be used for MIMO communications), and the channel bandwidth to be used for the PPDU (the 1-bit “20/40 BW” field). (DELL-1005, ¶¶64, 67-68, Figure 4c, ¶¶87, 97 (describing using HT-SIG field of Figure 4C in greenfield PPDU); §§V.B.3.a-b.) This information also specifies the type of packet being transmitted. (DELL-1003, ¶183.)

For each of these reasons, the combination of Hansen and July 2005 WWiSE discloses “*the first header field that [sic] indicates the type of packet*” [7] and “*the second header field that [sic] indicates the type of packet*” [8]. (DELL-1003, ¶¶181-184.)

VI. GROUND 2: The combination of Hansen, July 2005 WWiSE, and Choi renders claims 1-3, 5, 7-11, and 13 obvious.

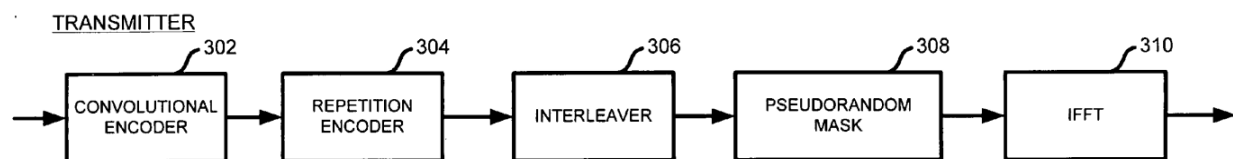
Petitioner established the combination of Hansen and July 2005 WWiSE renders claims 1-3, 5, 7-11, and 13 obvious. (See §§V.B.-D.) Should PO contend the combination of Hansen and July 2005 WWiSE does not suggest limitations [1J]/[9J] (the order of symbol generation for the second packet type), these limitations are explicitly disclosed by Choi.

A. Overview and Motivation to Combine

Choi is directed to “a repetition coding scheme for a wireless system.” (DELL-1008, ¶1.) Choi explains that in a typical system “bits representing a set of data that is to be communicated are convolutionally encoded or otherwise

transformed into values.” (DELL-1008, ¶13.) The coded values are modulated and an OFDM symbol transmitted. (*Id.*) To provide extended range, “each value that is sent is repeated several times by the transmitter.” (*Id.*) The values are also preferably “repeated in the frequency domain.” (*Id.*)

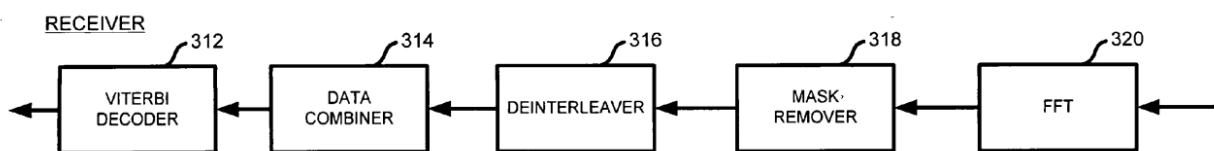
In Choi’s transmitter, illustrated in Figure 3A below, the repetition encoder is placed after the convolutional encoder and “before the input of an interleaver designed to handle repetition coded bits.” (DELL-1008, ¶26.) The “[i]ncoming data is convolutionally encoded by the convolutional encoder 302.” (*Id.*) The coded output “is repetition coded by repetition encoder 304”, resulting in two copies of the coded bit sequence. (*Id.*) In Choi, repetition is performed on a part-by-part (symbol-by-symbol) basis, meaning that for post-coding/pre-modulation repetition, a coded block corresponding to a symbol is repeated. (*See* DELL-1008, ¶18.) The repeated data is subsequently interleaved and modulated. (*See* DELL-1008, Figure 3A; DELL-1003, ¶¶209-212.)



Choi, Figure 3A

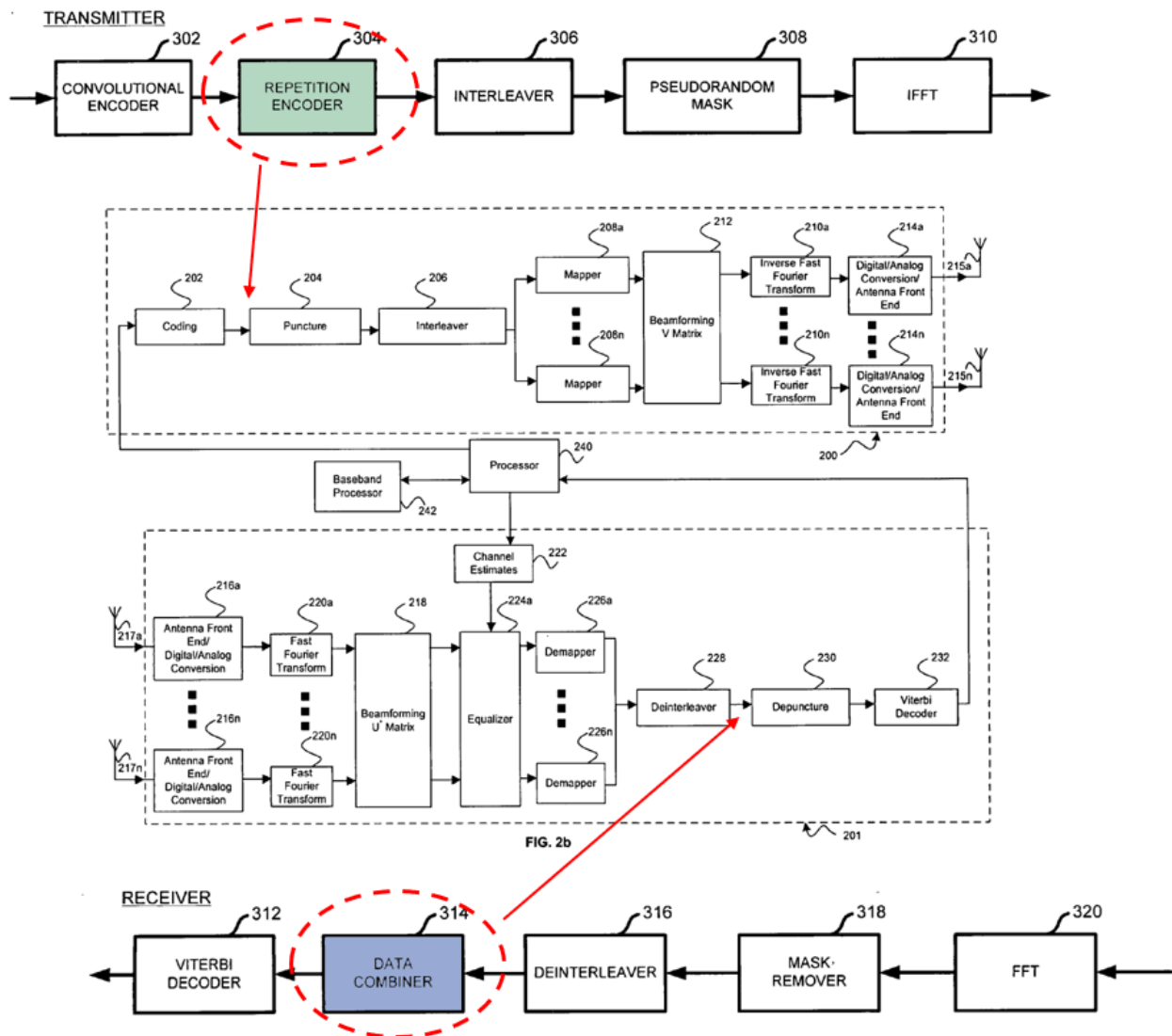
The receiver system corresponding to the transmitter of Figure 3A is illustrated in Figure 3B below. In the receiver, the “received signal is processed by

FFT processor 320.” (DELL-1008, ¶27.) A deinterleaver 316 deinterleaves the data.” (*Id.*) The data combiner 314 “combines the repetition encoded data into a stream of nonrepetitive data and “Viterbi decoder 312 determines the most likely sequence of data that was input to the transmission system originally.” (*Id.*)



Choi, Figure 3B

A POSITA would have been motivated to combine Choi’s repetition coding teachings with the combined system of Hansen and July 2005 WWiSE. (DELL-1003, ¶¶193-196.) Specifically, a POSITA would have been motivated to integrate a repetition encoder into the transmission portion of Hansen’s transceiver, as taught by Choi and illustrated below. (DELL-1003, ¶193.) Although Choi teaches repetition of “data” generally, a POSITA would have understood that Choi’s technique would be applicable to other fields carrying data such as the header. (DELL-1003, ¶193, *citing* DELL-1014, ¶83 (describing repetition of the header), DELL-1018, 51:1331-1358 (disclosing a repetition encoder for header field); DELL-1001, 1:56-58 (admitting the G.9960 specification is prior art and “should be familiar to those skilled in the art”).)



**Choi, Annotated Figure 3A (top); Hansen, Annotated Figure 2B (middle),
Choi, Annotated Figure 3B (bottom)**

A POSITA would have been motivated to combine Hansen, July 2005 WWiSE, and Choi because July 2005 WWiSE sets forth specifications for including repeating a header field in its PPDU's but does not provide details regarding how to implement such repetition in the transmission or reception

portions of a transceiver. (DELL-1003, ¶194.) Further, the header repetition of July 2005 WWiSE occurs before the IFFTs (pre-modulation) in the transmission chain because a frequency permutation is applied to the repeated version of the header. (See DELL-1006, 69:16-25; §§V.A.2, V.B.3.b.) Additionally, as discussed in §V.B.3.b, a POSITA would have been motivated to perform repetition post-coding in the combination of Hansen and July 2005 WWiSE for efficiency reasons. (DELL-1003, ¶194.) A POSITA would have therefore been motivated to search for references disclosing repetition coding post-coding/pre-modulation and would have been led to Choi because Choi is in the same field of endeavor as the '459 patent, Hansen, and July 2005 WWiSE—wireless transmission and reception using OFDM. (*Id.*)

Choi also expressly motivates the combination. (DELL-1003, ¶195.) First, Choi discloses that its disclosures are applicable to IEEE 802.11 standards, including 802.11a, b, g, and a/g. (See DELL-1008, ¶¶2, 17.) Second, Choi explicitly suggests the use of its repetition coding in systems having extended range capabilities, such as the system in the combination of Hansen and July 2005 WWiSE. (DELL-1008, ¶¶2, 15; DELL-1003, ¶195; See §V.A.3.) Third, Choi teaches that its repetition coding is beneficial for communication “in noisy environments”, which is a common concern for WLAN systems. (DELL-1008, ¶2; DELL-1003, ¶195.) Each of these suggestions would have motivated a POSITA to

combine Choi's repetition coding with Hansen and July 2005 WWiSE. (DELL-1003, ¶195.)

Finally, the combination is simply the combination of prior art elements (Hansen's "compromise" greenfield PPDU, WWiSE's ER capabilities, and Choi's repetition encoding) according to known methods to yield predictable results. The combination integrates Choi's repetition encoder in the transmission chain after coding and prior to interleaving. (DELL-1003, ¶196.) A POSITA would have understood how to integrate the repetition encoder in the transmission chain because transceiver design includes and incorporates the integration of other components such as puncturing between the coder and interleaver. (*See, e.g.*, DELL-1005, Figure 2b.) (*Id.*) The results of the combination would have been predictable and there would be a reasonable expectation of success in the combination because post-coding repetition encoders were proposed in other standards including G.9960. (*See Id.*; DELL-1018, 51:1331-1358 (disclosing a repetition encoder for header field).)

B. Independent Claim 1

The combination of Hansen, July 2005 WWiSE, and Choi discloses the *"encoder and [] modulator"* are *"operable to generate a first OFDM symbol followed by a second OFDM symbol followed by a third OFDM symbol followed by a fourth OFDM symbol"* [1J]. (DELL-1003, ¶197-201.)

In the combination of Hansen, July 2005, and Choi, coding block 202 receives the Signal*-N header bits, representing the “*first set of header bits*” (HT-SIG1) in the “*first part of the second header field*” and the “*third set of header bits*” (HT-SIG2) in the “*third part of the second header field.*” (See, e.g., §IV.B.3.b.) The output of coding block 202 is the coded HT-SIG1 followed by the coded HT-SIG2. As I discussed in §IV.B.3.b, coded HT-SIG1 corresponds to the HT-SIG1 header bits and the transmitted HT-SIG1 symbol and coded HT-SIG2 corresponds to the HT-SIG2 header bits and the transmitted HT-SIG2 symbol (DELL-1003, ¶198.)

The coded HT-SIG1, output first, is provided to the repetition encoder where it is duplicated to generate a second instance of coded HT-SIG1. (See DELL-1008, ¶¶26, 18 (repetition applied to a coded block corresponding to an OFDM symbol).) The coded HT-SIG2 is next provided to the repetition encoder where it is duplicated to generate a second instance of coded HT-SIG2. (See DELL-1008, ¶26.) The coded and repeated blocks sequentially traverse the transmission chain, resulting in the following order of transmitted symbols: HT-SIG1 symbol, ER-HT-SIG1 symbol, HT-SIG2 symbol, and ER-HT-SIG2 symbol. (See DELL-1008, ¶26.)

Because the order of transmission is the same as the order of reception, The combination of Hansen, July 2005 WWiSE, and Choi discloses “*demodulator*

further operable to demodulate a first OFDM symbol followed by a second OFDM symbol followed by a third OFDM symbol followed by a fourth OFDM symbol”
[1I].

The combination of Hansen, July 2005 WWiSE, and Choi disclose the remaining limitations of independent claim 1 for the reasons discussed in §V.B.

Thus, the combination of Hansen, July 2005 WWiSE, and Choi renders independent claim 1 obvious.

C. Independent Claim 9

As discussed in §V.C., claim 9 recites substantially the same limitations as claim 1. For the reasons discussed in §VI.B. for limitation [1J] and the reasons discussed in §V.B. for the remaining terms, the combination of Hansen, July 2005 WWiSE, and Choi renders claim 9 obvious.

D. Dependent Claims

For the reasons discussed in §V.D., the combination of Hansen, July 2005 WWiSE, and Choi renders claims 2-3, 5, 7-8, 10-11, and 13 obvious.

VII. Discretionary Denial Is Not Appropriate.

PO brought four separate litigations asserting the ’459 patent against Dell, against Lenovo Group Ltd., against HP Inc., and against Acer Inc. The Board should decline to exercise its discretion to deny institution in this case for the reasons set forth below. First, Dell has offered a stipulation in the litigation,

consistent with *Sotera Wireless*. (See DELL-1041.) The *Sotera* stipulation from Dell removes any overlap between this IPR proceeding and the litigation between the parties. “Consistent with *Sotera Wireless, Inc.*, the PTAB will not discretionarily deny institution in view of parallel district court litigation where a petitioner presents a stipulation not to pursue in a parallel proceeding the same grounds or any grounds that could have reasonably been raised before the PTAB.” (*Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation* (June 21, 2022) (“*Fintiv* Memo”), 3.) Given the *Sotera* stipulation and the *Fintiv* Memo’s guidance, the Board should decline to exercise its discretion to deny institution.

In addition, the *Fintiv* factors weigh heavily against discretionary denial. Dell has filed an opposed motion to stay the litigation between the parties pending the outcome of Intel’s IPR for the ’459 patent which has recently instituted. (See DELL-1047.) Thus *Fintiv* factor 1 weighs in favor of granting institution. Further, the median time to trial for Judge Schroeder is just over thirty months. (See DELL-1046.) The final written decision in this proceeding will issue within a month of that. Although the trial in the Dell litigation is currently scheduled for July 15, 2024, this date remains speculative because the district court has at least two other patent trials scheduled for the same date. (See DELL-1042, DELL-1043, DELL-1044, DELL-1045.) So *Fintiv* factor 2 is neutral. Due to multiple

adjustments to the schedules, much substantive work remains, including expert discovery and dispositive motions, rendering *Fintiv* factor 3 neutral at a minimum.

Moreover, discretionary denial is inappropriate here because the Petition presents a “compelling, meritorious challenge.” (*Fintiv* Memo, 4.) The challenged claims merely recite repeating two portions of an extended header in a specific order. Extending a header and repeating header portions were known, as demonstrated by Hansen and WWiSE and acknowledged by PO as publicly discussed in submissions to ITU-T G.hn Standard. (*See* p. 8, *supra*.) And the specific order for generating the two repeated portions of the extended header would have been obvious to a POSITA because only a very limited number of options exist for generating and repeating two pieces of information. WWiSE suggests the ordering, and the specific ordering improves efficiency in both the reception and transmission chains. (*See* pp., 41-45, *supra*.) Thus, Petitioner’s arguments and evidence, if unrebutted at trial, would “lead to a conclusion that one or more claims are unpatentable.” (*Fintiv* Memo, 4.)

VIII. Mandatory Notices

A. Real Party In Interest

The real parties in interest include Petitioner, as well as Intel Corporation, and Lenovo Group Ltd.

B. Related Matters

To the best of Petitioner's knowledge, the '459 patent is involved in the following district court litigations:

- *AX Wireless LLC, v. Dell Inc., and Dell Technologies Inc.*, 2-22-cv-00277 (EDTX).
- *AX Wireless LLC, v. Lenovo Group Ltd.*, 2-22-cv-00280 (EDTX).
- *AX Wireless LLC, v. HP Inc.*, 2-22-cv-00279 (EDTX).
- *AX Wireless LLC, v. Acer Inc.* 2-23-cv-00041 (EDTX)

C. Notice Of Counsel And Service Information

Pursuant to 37 C.F.R. §§42.8(b)(3), 42.8(b)(4) and 42.10(a), Dell appoints the following lead and backup counsel.

Lead Counsel	Back Up Counsel
Jonathan R. Carter (Reg. No. 75,145) Perkins Coie LLP 1155 Avenue of the Americas, 22nd Floor New York, New York 10036 Carter-ptab@perkinscoie.com Tel: (212) 261-6826 Fax: (212) 977-1649	Bryan S. Banks (Reg. No. 52,588) Perkins Coie LLP 2901 North Central Avenue, Suite 2000 Phoenix, Arizona 85012 Banks-ptab@perkinscoie.com Tel: (602) 351-8096 Fax: (602) 648-7043
	Matthew W. Hindman (Reg. No. 57,398) Perkins Coie LLP 3150 Porter Drive Palo Alto, CA 94304-1212 Tel: (650) 838-4372 Fax: (650) 838-4350

Dell consents to electronic service by email at the email addresses: Carter-ptab@perkinscoie.com, Banks-ptab@perkinscoie.com, and hindman-ptab@perkinscoie.com.

IX. Conclusion

Inter partes review of the challenged claims is respectfully requested.

Respectfully submitted,

/ Jonathan R. Carter /

Jonathan R. Carter
(Reg. No. 75,145)
Attorney for Petitioner

PERKINS COIE LLP
1155 Avenue of the Americas,
22nd Floor
New York, New York 10036

Date: March 14, 2024

APPENDIX A - LIST OF INDEPENDENT CLAIMS

Claim 1
[1P] A wireless OFDM (Orthogonal Frequency Division Multiplexing) transceiver comprising:
[1A] a wireless OFDM communications receiver operable to receive, over a wireless communication channel, a first packet type in a first channel bandwidth,
[1B] the first packet type comprising a first header field, wherein the first header field comprises two parts, a first part comprising a first set of header bits of the first header field and a second part comprising a second set of header bits of the first header field,
[1C] wherein the first set of header bits of the first header field is different than the second set of header bits of the first header field; and
[1D] a demodulator operable to demodulate a first OFDM symbol followed by a second OFDM symbol,
[1E] wherein the first OFDM symbol is used to receive the first part of the first header field and the second OFDM symbol is used to receive the second part of the first header field,
[1F] the wireless OFDM communications receiver further operable to receive, over the wireless communications channel, a second packet type in a second channel bandwidth,
[1G] the second packet type comprising a second header field, wherein the second header field comprises four parts, a first part comprising a first set of header bits of the second header field, a second part comprising a second set of header bits of the second header field, a third part comprising a third set of header bits of the second header field and a fourth part comprising a fourth set of header bits of the second header field,
[1H] wherein the first set of header bits of the second header field is the same as the second set of header bits of the second header field, wherein the third set of header bits of the second header field is the same as the fourth set of header bits of the second header field,
[1I] the demodulator further operable to demodulate a first OFDM symbol followed by a second OFDM symbol followed by a third OFDM symbol followed by a fourth OFDM symbol,

Claim 1
[1J] wherein the first OFDM symbol is used to receive the first part of the second header field, the second OFDM symbol is used to receive the second part of the second header field, the third OFDM symbol is used to receive the third part of the second header field, the fourth OFDM symbol is used to receive the fourth part of the second header field,
[1K] wherein the second set of header bits of the second header field received using the second OFDM symbol are received in a different order than the first set of header bits of the second header field received using the first OFDM symbol,
[1L] wherein the fourth set of header bits of the second header field received using the fourth OFDM symbol are received in a different order than the third set of header bits of the second header field received using the third OFDM symbol, and
[1M] wherein the first channel bandwidth is at least two times wider than the second channel bandwidth.

Claim 9
[9P] A method of operating a wireless OFDM (Orthogonal Frequency Division Multiplexing) transceiver comprising:
[9A] receiving, by a wireless OFDM communications receiver over a wireless communication channel, a first packet type in a first channel bandwidth,
[9B] the first packet type comprising a first header field, wherein the first header field comprises two parts, a first part comprising a first set of header bits of the first header field and a second part comprising a second set of header bits of the first header field,
[9C] wherein the first set of header bits of the first header field is different than the second set of header bits of the first header field;
[9D] demodulating, by a demodulator, a first OFDM symbol followed by a second OFDM symbol,
[9E] wherein the first OFDM symbol is used to receive the first part of the first header field and the second OFDM symbol is used to receive the second part of the first header field;

Claim 9
[9F] receiving, by the wireless OFDM communications receiver over the wireless communication channel, a second packet type in a second channel bandwidth;
[9G] the second packet type comprising a second header field, wherein the second header field comprises four parts, a first part comprising a first set of header bits of the second header field, a second part comprising a second set of header bits of the second header field, a third part comprising a third set of header bits of the second header field and a fourth part comprising a fourth set of header bits of the second header field,
[9H] wherein the first set of header bits of the second header field is the same as the second set of header bits of the second header field, wherein the third set of header bits of the second header field is the same as the fourth set of header bits of the second header field,
[9I] and demodulating, by the demodulator, a first OFDM symbol followed by a second OFDM symbol followed by a third OFDM symbol followed by a fourth OFDM symbol,
[9J] wherein the first OFDM symbol is used to receive the first part of the second header field, the second OFDM symbol is used to receive the second part of the second header field, the third OFDM symbol is used to receive the third part of the second header field, the fourth OFDM symbol is used to receive the fourth part of the second header field,
[9K] wherein the second set of header bits of the second header field received using the second OFDM symbol are received in a different order than the first set of header bits of the second header field received using the first OFDM symbol,
[9L] wherein the fourth set of header bits of the second header field received using the fourth OFDM symbol are received in a different order than the third set of header bits of the second header field received using the third OFDM symbol, and
[9M] wherein the first channel bandwidth is at least two times wider than the second channel bandwidth.

APPENDIX B - ACRONYM LIST

Acronym	Expansion
BCC	Binary Convolutional Coding
BW	Bandwidth
CBPS	Coded Bits Per Symbol
CRC	Cyclic Redundancy Check
DAC	Digital/Analog Conversion
DBPS	Data Bits Per Symbol
DSSS	Direct-Sequence Spread-Spectrum
EH	Extended Header Indication
ER	Extended Range
FEC	Forward Error Correction
FHSS	Frequency-Hopping Spread Spectrum
GI	Guard Interval
HT-LTF	High-Throughput Long Training Field
HT-SIG	High-Throughput Signal Field
HT-STF	High-Throughput Short Training Field
IEEE	Institute of Electrical and Electronics Engineers
IFFT	Inverse Fast Fourier Transform
IP	Internet Protocol
IREHI	Immediate Response Frame Extended Header Indication
ITU	International Telecommunication Union
ITU-T	ITU Telecommunication Standardization Sector
LAN	Local Area Network
LLC	Logical Link Control
MAC	Media Access Control
MCS	Modulation and Coding Scheme
MIMO	Multiple Input Multiple Output
MPDU	MAC Protocol Data Unit
NR	Normal Range
OFDM	Orthogonal Frequency Division Multiplexing
OSI	Open Systems Interconnection Model
PCS	Physical Coding Sub-layer
PHY	Physical Layer
PLCP	Physical Layer Convergence Protocol
PMA	Physical Medium Attachment
PMD	Physical Medium Dependent

Acronym	Expansion
PPDU	Physical Layer Protocol Data Unit
PSDU	PLCP Service Data Unit
RF	Radio Frequency
RX	Receiver
TCP	Transmission Control Protocol
TGn	IEEE 802.11n Task Group
TX	Transmitter
UDP	User Datagram Protocol
WLAN	Wireless Local Area Network
WWiSE	World-Wide Spectrum Efficiency

CERTIFICATE OF WORD COUNT UNDER 37 CFR §42.24(d)

Pursuant to 37 C.F.R. §42.24(a), Dell hereby certifies that portions of the above-captioned Petition for *Inter Partes* Review of U.S. Patent No. 10,554,459, in accordance with and reliance on the word count provided by the word-processing system used to prepare this Petition, that the number of words in this paper is 13,320. Pursuant to 37 C.F.R. §42.24(a), this word count is in compliance and excludes the table of contents, table of authorities, mandatory notices under §42.8, certificate of service, certificate of word count, appendix of exhibits, and any claim listing. This word count was prepared using Microsoft Word.

Respectfully submitted,

/ *Jonathan R. Carter* /

Jonathan R. Carter
Attorney for Petitioner

Date: March 14, 2024

CERTIFICATE OF SERVICE

The undersigned hereby certifies that true copies of the Petition for *Inter Partes* Review of U.S. Patent No. 10,554,459 and supporting materials (Exhibits and Power of Attorney) were served via overnight delivery on the Patent Owner at the correspondence address of record as listed in USPTO records:

Andrew Park
Park, Kim & Suh, LLC
2121 Avenue of the Stars, Suite 800
Century City, CA 90067

and via email to the attorneys of record for Plaintiff in the concurrent *AX Wireless LLC, v. Dell Inc., and Dell Technologies Inc., 2-22-cv-00277 (EDTX), AX Wireless LLC, v. HP Inc., 2-22-cv-00279 (EDTX), and AX Wireless LLC, v. Lenovo Group Ltd., 2-22-cv-00280 (EDTX)* litigations:

AXWIRELESSLLC-WIFI6LITIGATION.LWTEAM@lw.com

Kevin Christopher Wheeler - kevin.wheeler@lw.com
Srinivas Giriraj Pathmanaban - giri.pathmanaban@lw.com
Bradley A. Hyde - bradley.hyde@lw.com
Charles Everingham, IV - ce@wsfirm.com
Claire Abernathy Henry - claire@wsfirm.com
Clement Naples - clement.naples@lw.com
David Hlavka - david.hlavka@lw.com
Garrett C. Parish - gparish@wsfirm.com
Jacob Vannette - jake.vannette@lw.com

Respectfully submitted,

/ Jonathan R. Carter /

Jonathan R. Carter
Attorney for Petitioner

Date: March 14, 2024