

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ZTE (USA) INC. AND COOLPAD TECHNOLOGIES, INC.,
Petitioners,

v.

BELL NORTHERN RESEARCH, LLC,
Patent Owner.

PTAB Case No. IPR2019-01345

Patent No. 7,990,842

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 7,990,842**

Claims 1-4, 8, 11, 14, and 19

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EX1003 ¹	Declaration of Dr. Jonathan Wells
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EX1005	U.S. Pub. No. 2004/0093545 to Khandani et al. (“Khandani”)
EX1006	U.S. Pub. No. 2005/0286474 to Zelst et al. (“Zelst”)
EX1007	“IEEE Std 802.11a-1999” (“IEEE”)
EX1008	U.S. Pub. No. 2007/0060073 to Boer et al. (“Boer”)
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EX1011	Defendants’ Invalidity Contentions in <i>Bell Northern Research, LLC v. Coolpad Technologies, Inc. and Yulong Computer Communications</i> (Case No. 3:18-cv-1783) (S.D. Cal.)

¹ Exhibit 1003 is a verbatim copy of the Declaration of Jonathan Wells submitted on behalf of Petitioner Huawei in support of their Petition for *Inter Partes* Review of the 7,990,842 patent in IPR2019-1174.

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EX1018	Plaintiff's Opposition to Defendants' Joint Motion for Summary Judgment of Indefiniteness in <i>Research, LLC v. Coolpad Technologies, Inc. and Yulong Computer Communications</i> (Case No. 3:18-cv-1783) (S.D. Cal.)
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I. INTRODUCTION

ZTE (USA) Inc. (“ZTE”) and Coolpad Technologies, Inc. (“Coolpad”) (collectively “Petitioners”) petition for *Inter Partes* Review (“Petition”) under 35 U.S.C. §§ 311-319 and 37 C.F.R. §42 of claims 1-4, 8, 11, 14, and 19 (“the
5 Challenged Claims”) of U.S. Patent 7,990,842 (“the ’842 patent”).

On June 12, 2019, Huawei Technologies Co., Ltd. filed a petition for *Inter Partes* Review (“Huawei IPR Petition”), PTAB Case No. IPR2019-1174, of U.S. Patent No. 7,990,842. This Petition and the Huawei IPR Petition are identical in their invalidity grounds, prior art, analyses, and evidence. Both request review of
10 the same claims, based on the same references in the same combinations, rely on the same expert, and the same expert declaration. At this time, the Huawei IPR Petition is waiting for the Board’s decision on whether to institute an IPR trial.

This Petition shows, by a preponderance of the evidence, that there is a reasonable likelihood that Petitioners will prevail on at least one of the challenged
15 claims of the ’842 patent based on prior art that the U.S. Patent Office did not have before it or did not fully consider during prosecution, and that renders these claims anticipated or obvious. Accordingly, Petitioners request the Board institute *inter partes* review of claims 1-4, 8, 11, 14, and 19.

II. MANDATORY NOTICES UNDER 37 C.F.R §42.8

A. Real Parties-In-Interest Under 37 C.F.R. §42.8(b)(1)

All real parties in interest for this Petition are identified below:

For Petitioner ZTE (USA) Inc., all real parties in interest are: ZTE

5 Corporation, ZTE (USA) Inc., and ZTE (TX), Inc.

For Petitioner Coolpad Technologies, Inc., all real parties in interest are:

Coolpad Technologies, Inc., Coolpad Group, Ltd., Yulong Computer

Telecommunication Technology (Shenzhen) Co., Ltd. (identified as Yulong

Computer Communications), Digital Tech Inc. (BVI), and Yulong Infotech Inc.

10 (BVI).

No other parties had access to or control over the present Petition prior to the filing of IPR2019-1174 (“Huawei IPR”), and no other parties funded the present Petition.

B. Related Matters Under 37 C.F.R. § 42.8(b)(2)

15 BNR—the alleged Patent Owner—filed a complaint on August 1, 2018 in the U.S. District Court for the Southern District of California against both Coolpad (Case No. 3:18-cv-1783) and ZTE (Case No. 3:18-cv-1786). The Coolpad

complaint asserted 5 patents, including the '842 patent.² The ZTE complaint asserted 6 patents, including the '842 patent. BNR filed a first amended complaint against ZTE on October 15, 2018 asserting two additional patents. Both original complaints were served on Coolpad and ZTE on August 3, 2018.

5 BNR also filed complaints in the Southern District of California alleging infringement of the '842 patent by other parties: Huawei Device (Dongguan) Co., Ltd., Huawei Device (Shenzhen) Co., Ltd., and Huawei Device USA, Inc. (3:18-cv-1784); Kyocera Corporation and Kyocera International Inc. (3:18-cv-1785); and LG Electronics, Inc., LG Electronics U.S.A. Inc., and LG Electronics Mobile
10 Research U.S.A., LLC (3:18-cv-2864). Coolpad nor ZTE is a real party-in-interest to any of these above-listed district court proceedings. Also, none of the parties in these district court proceedings is a real party-in-interest in the proceedings involving Coolpad or ZTE or in privity with Coolpad or ZTE.

 The '842 patent is in the same family as U.S. Patent No. 7,646,703 and U.S.
15 Patent No. 8,477,594. Other petitioners have filed petitions related to the '842 patent in IPR2019-1174.

² U.S. Patent No. 8,792,432 was dismissed on November 29, 2018. (3:18-cv-01783-CAB-BLM Doc. No. 42).

C. Lead And Back-Up Counsel Under 37 C.F.R. §42.8(b)(3)

Petitioners provide the following designation of counsel.

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D. Service Information

Please address all correspondence to the address above. Petitioners consent to electronic service by email at ZTEBNR-PTAB@mwe.com (referencing No.

IPR2019-01345) and PerkinsServiceCoolpad-BNR@perkinscoie.com (referencing

5 No. IPR2019-01345 and cc'ing docketipr@perkinscoie.com).

III. PAYMENT OF FEES – 37 C.F.R. §42.103

Petitioners authorize the Office to charge Deposit Account No. 50-0417 for the petition fee set in 37 C.F.R. §42.15(a) and for any other required fees.

IV. REQUIREMENTS FOR IPR UNDER 37 C.F.R. § 42.104

5 A. Grounds for Standing Under 37 C.F.R. § 42.104(a)

Petitioners certify that the '842 patent is available for IPR and that
Petitioners are not barred or estopped from requesting IPR.

B. Challenge Under 37 C.F.R. § 42.104(b) and Relief Requested

Petitioners request an IPR of claims 1-4, 8, 11, 14, and 19 on the grounds
10 listed below, and requests that each of the Challenged Claims be found
unpatentable. In support, this petition includes a declaration of Jonathan Wells
(EX1003).

Ground	'842 Patent Claims	Basis for Rejection
1	1-4, 8, 11, 14, 19	§102 – U.S. Pat. No. 7,453,793 (“Jones”)
2	1-4, 8, 11, 14, 19	§103 – Jones in view of U.S. Pub. No. 2004/0093545 (“Khandani”)

3	1-4, 8, 11, 14, 19	§103 – “IEEE Std 802.11a-1999” (“IEEE”) in view of U.S. Pub. No. 2005/0286474 (“Zelst”)
4	1-4, 8, 11, 14, 19	§103 – IEEE in view of Zelst and Khandani

The '842 patent claims priority to U.S. Provisional Application No. 60/634,102, filed December 8, 2004, and U.S. Provisional Application No. 60/591,104, filed July 27, 2004. For purposes of this petition, Petitioners treat July 27, 2004 as the earliest possible priority date of the '842 patent.

5 Jones was filed April 12, 2004 and issued as a patent on November 18, 2008. Jones qualifies as prior art at least under 35 U.S.C. §102(e) because it was filed before the earliest possible priority date of the '842 patent. Khandani is a U.S. patent application that was filed December 9, 2002, and published May 13, 2004. Khandani qualifies as prior art at least under 35 U.S.C. §102(a) and §102(e). The
10 evidence here confirms the IEEE reference published on December 30, 1999, and thus qualifies as prior art under at least 35 U.S.C. §102(b). EX1015, ¶¶5-8.

Zelst is a U.S. patent application that was filed May 27, 2005, and published December 29, 2005. Zelst claims priority to U.S. Provisional Application No. 60/575,608 (“’608 Provisional”), filed May 27, 2004. As explained below in
15 Section IX.A, the '608 Provisional provides written description support for all

aspects of Zelst cited in this petition and further supports at least one claim of Zelst, and thus Zelst qualifies as prior art under §102(e). *Dynamic Drinkware, LLC, v. National Graphics, Inc.*, 800 F.3d 1375 (Fed. Cir. 2015); see EX1003, ¶¶182-183.

5 V. SUMMARY OF THE '842 PATENT

A. Background

In its description of related art, the '842 patent explains that wireless communication devices include “a built-in radio transceiver (i.e., receiver and transmitter)” or are “coupled to an associated radio transceiver.” EX1001,

10 1:24-28. A transmitter usually includes a data modulation stage, where raw data is converted into baseband signals; intermediate frequency stages, where baseband signals are mixed with local oscillations to produce RF signals; and a power amplifier that amplifies the RF signals prior to transmission via an antenna. *Id.*, 1:28-36.

15 The '842 patent explains that “[d]ifferent wireless devices in a wireless communication system may be compliant with different standards or different variations of the same standard,” such as 802.11a, 802.11b, 802.11g, and 802.11n, which are all extensions of the 802.11 standard. *Id.*, 1:50-60. A wireless local area network (WLAN) may include devices that are compliant with different standards.

Id., 1:60-62. Devices that are “compliant with older versions are considered to be legacy devices.” *Id.*, 1:62-65.

Devices that are compliant with “both the 802.11a and the 802.11g standard use an orthogonal frequency divisional multiplexing (OFDM) encoding scheme,” a
5 technique for “transmitting large amounts of digital data over a radio wave” by “spreading a single data stream over a band of sub-carriers. *Id.*, 2:8-14. In both 802.11a and 802.11g compliant devices, the band includes 64 sub-carriers, where only 52 are used, or active. *See id.*, 2:14-16. Four of the 52 active sub-carriers are used “as a reference to disregard frequency or phase shifts of the signal during
10 transmission.” *Id.*, 2:16-18. The remaining 48 sub-carriers are used to provide pathways for sending information in parallel. *Id.*, 2:19-20. All 52 active sub-carriers are modulated, for example, using binary phase shift key (BPSK) encoding. *Id.*, 2:20-23. Additionally, 802.11a and 802.11g-compliant devices “use sub-carriers -26 to +26, with the 0-index subcarrier set to 0, where the 0-index sub-
15 carrier is the carrier frequency.” *Id.*, 2:23-27. Data packets used in 802.11a and 802.11g compliant devices start with “a preamble which includes a short training sequence followed by a long training sequence,” where the long training sequence is “defined such that each of sub-carriers -26 to +26 has one BPSK constellation point, either +1 or -1. *Id.*, 2:29-35. The annotated image below shows a “long
20 training sequence L_1 that is used to generate the signal representing the long

training symbol in a conventional 802.11a preamble.” EX1004, 2:14-16, FIG. 2.

The L_1 sequence “represents values [] used for each of the 64 subcarriers,” with the first value corresponding to the 0-index subcarrier (*e.g.*, DC subcarrier), followed by values for subcarrier indices +1 to +31, followed by values for subcarrier

5 indices 32 to -1. *Id.*, 2:16-27; *see also* EX1003, ¶¶39-45. In the L_1 sequence, the DC value and the values at subcarrier indices +27 to +31 and -32 to -27

(highlighted in yellow) are zero. EX1001, FIG. 2. For illustrative purposes, index numbers are annotated here in red:

$$L_1 = \{ \begin{matrix} 0^0 & 1^1 & -1^2 & -1^3 & 1^4 & 1^5 & -1^6 & 1^7 & -1^8 & 1^9 & -1^{10} & -1^{11} & -1^{12} & -1^{13} & -1^{14} & 1^{15} \\ 1^{16} & -1^{17} & -1^{18} & 1^{19} & -1^{20} & 1^{21} & -1^{22} & 1^{23} & 1^{24} & 1^{25} & 1^{26} & 0^{27} & 0^{28} & 0^{29} & 0^{30} & 0^{31} \\ 0^{32} & 0^{31} & 0^{30} & 0^{29} & 0^{28} & 0^{27} & 1^{26} & 1^{25} & -1^{24} & -1^{23} & 1^{22} & 1^{21} & -1^{20} & -1^{19} & -1^{18} & 1^{17} \\ 1^{16} & 1^{15} & 1^{14} & 1^{13} & 1^{12} & -1^{11} & -1^{10} & 1^{9} & 1^{8} & -1^{7} & 1^{6} & -1^{5} & 1^{4} & 1^{3} & 1^{2} & 1^1 \end{matrix} \}$$

FIG. 2
(PRIOR ART)

10 *Id.* (color added, annotated).

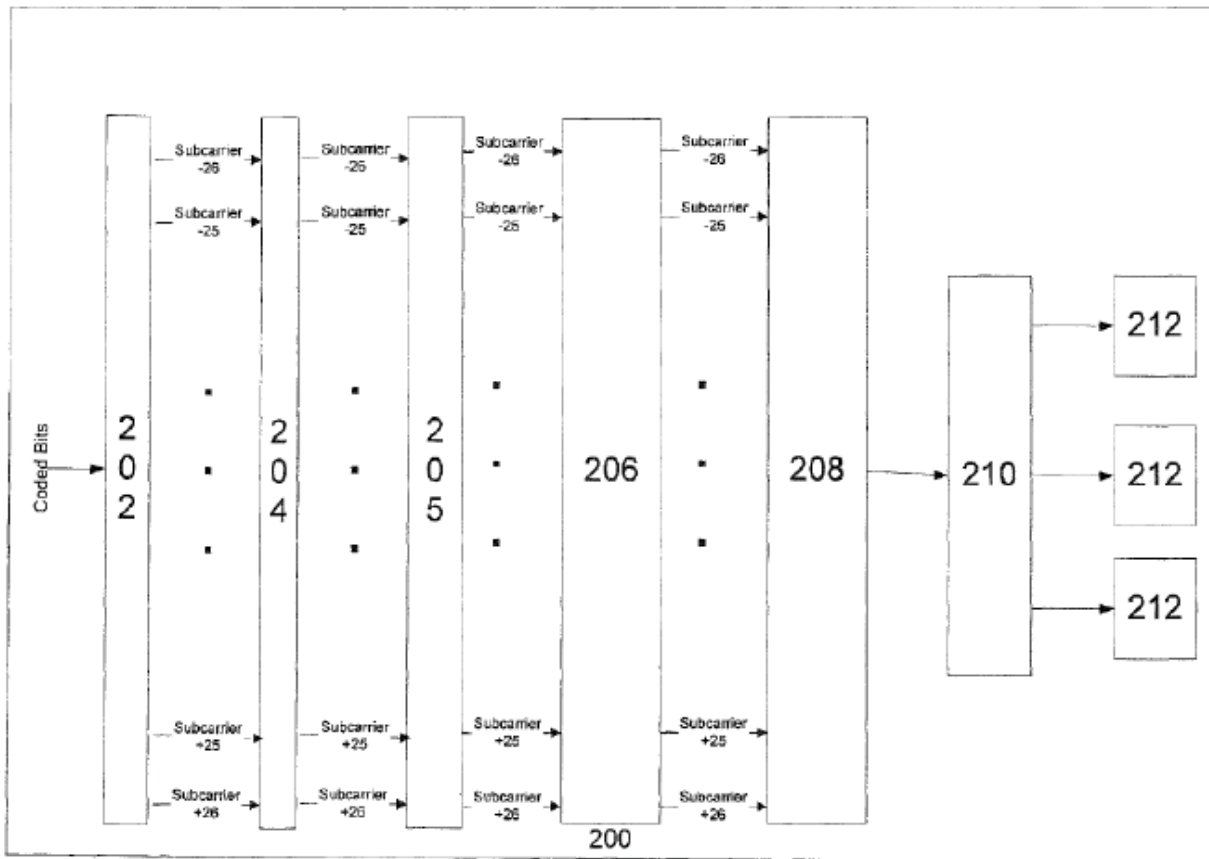
According to the '842 patent, there existed “a need to create a long training sequence of minimum peak-to-average ratio that uses more sub-carriers without interfering with adjacent channels” where the long training sequences (LTSs) are “usable by legacy devices in order to estimate channel impulse response and to

15 estimate carrier frequency offset between a transmitter and a receiver.” EX1001, 2:36-43.

B. Brief Description of the '842 Patent

Generally, the '842 patent purportedly describes a “network device for generating an expanded long training sequence with a minimal peak-to-average ratio.” EX1001, Abstract. Providing such an expanded long training sequence
5 “thereby decreases power back-off.” *Id.*, 4:4-6. The expanded LTS is “usable by 802.11a or 802.11g systems only if the values at sub-carriers -26 to $+26$ are identical to those of the current long training sequence used in 802.11a and 802.11g systems,” so “ $+1$ or -1 binary phase shift key (BPSK) encoding [is used] for each new subcarrier and the long training sequence of 802.11a or 802.11g
10 systems is maintained.” *Id.*, 4:10-18.

Figure 2 shows a block diagram of a processor configured to generate an expanded LTS, where the processor includes a symbol mapper 202, a frequency domain window 204, a signal generating circuit 205, an inverse fast Fourier transform (IFFT) module 206, a serial to parallel module 208, a digital transmit
15 filter and/or time domain window module 210, and digital to analog converters 212. *Id.*, FIG. 2, 4:30-37.



EX1001, FIG. 2.

The '842 patent discloses the signal generating circuit generating the expanded LTS, so that, if 63 active sub-carriers are being used, the expanded LTS is stored in sub-carriers -32 to +31, except the 0-index sub-carrier, which is set to 0. *Id.*, 4:45-50. Figure 5 (reproduced below) shows an LTS with a minimum peak-to-average power ratio (PAPR) that is used in 63 active sub-carriers. *Id.*, 5:20-22. Of the 2,048 (2^{11}) permutations for the 11 new sub-carriers, the sequence in Figure 5 has the minimum PAPR of 3.6 dB. *Id.*, 5:22-25. As shown in Figure 5, the values at subcarrier indices +27 to +31 and -32 to -27 (highlighted below),

previously set to 0 in LTSs that used only 52 active subcarriers, have non-zero values:

-1	-1	+1	+1	+1	+1	1	1	-1	-1	1	1	-1	1	-1	1	1	1
-32	-31	-30	-29	-28	-27	-26	-25	-24	-23	-22	-21	-20	-19	-18	-17	-16	-15

Sub-carrier index

1	1	1	-1	-1	1	1	-1	1	-1	1	1	1	1	0
-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0

Sub-carrier index

+1	-1	-1	1	1	-1	1	-1	1	-1	-1	-1	-1	-1	-1
1	2	3	4	5	6	7	8	9	10	11	12	13	14	

Sub-carrier index

1	1	-1	-1	1	-1	1	-1	1	1	1	1	-1	-1	-1	+1	-1
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

Sub-carrier index

EX1001, FIG. 5 (color added).

5 C. Summary of the Prosecution History of the '842 Patent

The claims of the '842 patent were allowed after a brief examination that included only double patenting rejections. The '842 patent was filed with 15 claims and a concurrently-filed preliminary amendment that canceled all but claim 1. EX1002, 60, 71-72. In the first Office action, the examiner rejected claim 1 based on "same invention"-type double patenting over US7,646,703. *Id.*, 48. Applicant responded by canceling claim 1 and adding claims 16-35. *Id.*, 37-43. In the second Office action, the examiner rejected claims 16-35 under obviousness-type double patenting over US7,646,703. *Id.* at 32-36. In response, Applicant

filed a terminal disclaimer. *Id.*, 23-27. The '842 patent was then allowed on April 18, 2011. *Id.*, 14.

D. Level of Ordinary Skill

For purposes of this IPR, Petitioners submit that a person of ordinary skill in the art at the time of the alleged invention (a “POSITA”) would have had at least a bachelor’s degree in electrical engineering, or some similar technical field, along with two to three years of experience with wireless networks, such as experience with wireless local area or mobile networks. Additional education could substitute for some of the experience, and substantial experience could substitute for some of the educational background. EX1003, ¶¶23-24.

VI. CLAIM CONSTRUCTION UNDER 37 C.F.R. §§ 42.104(B)(3)

Petitioners submit that all claim terms should be construed according to the *Phillips* standard. *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005); 37 C.F.R. § 42.100. The following construction is provided to assist the Board in assessing the plain and ordinary meaning of the claims under the *Phillips* standard.

Petitioners notify the Board here that the claim terms discussed below are subject to alternative interpretations³ described below. For each term, the claim scope encompasses the prior art in Grounds 1-4 under both alternatives, so

Petitioners recognize the Board may decide no formal construction is necessary at

5 the institution stage. *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361

(Fed. Cir. 2011) (“claim terms need only be construed to the extent necessary to resolve the controversy”). In other words, the Grounds cited here apply to the

challenged claims—regardless of whether the Board adopts a formal construction

of these four terms—due to the straightforward overlap between the cited prior art

10 examples and the preferred embodiment of the ’842 patent.

³ The Board has previously authorized the use of alternative constructions in IPR petitions, and Petitioners should be treated no differently here. *General Electric Co. v. Vestas Wind Systems A/S*, IPR2018-00928, Paper 9, 12-16 (PTAB Nov. 5, 2018); *Intel Corp. v Qualcomm Inc.*, IPR2018-01340, Paper 8, 11-13 (PTAB Jan. 15, 2019); *Hologic, Inc. v Enzo Life Sciences, Inc.*, IPR2018-00019, Paper 21, 7 (PTAB Nov. 28, 2018).

A. “a standard wireless networking configuration for an Orthogonal Frequency Division Multiplexing scheme” (claim 1)

According to a first interpretation, the phrase “a standard wireless networking configuration for an Orthogonal Frequency Division Multiplexing scheme” means “a standard issued by a Standard Setting Organization (for example, IEEE or 3GPP) utilizing an Orthogonal Frequency Division Multiplexing scheme.” Under this interpretation, the claim term encompasses the preferred embodiment of the ’842 patent, which states that “[d]evices implementing both the 802.11a and 802.11g standards use an orthogonal frequency division multiplexing (OFDM) encoding scheme” and that “[i]n 802.11a and 802.11g compliant devices, only 52 of the 64 active subcarriers are used.” EX1001, 2:8-10, 2:14-16. As detailed below, Jones and Zelst teach this same LTS with more than the 52 subcarriers used in the 802.11a or 802.11g standard. *Infra*, Sections VII.B, VIII.B, IX.C, X, and XI.B (analysis of element [1.d]); EX1003, ¶¶53, 117.

According to a second interpretation, the claim phrase plainly encompasses at least the preferred embodiment in the specification, but the outermost boundaries of this claim term are ambiguous for purposes of determining infringement. There is no dispute that, according to the preferred embodiment, the claim scope would encompass 802.11a or 802.11g standards of the inventors’ preferred embodiment: “The inventive expanded long training sequence may be

used by 802.11a or 802.11g devices...” EX1001, 4:6-8. 4:10-19. Under this interpretation, although a POSITA would recognize that 802.11a and 802.11g standards fall within the scope of the claim (and are readily comparable to the prior art examples cited below), the outermost boundaries of “a standard wireless
5 networking configuration ...” are not defined for purposes of determining infringement⁴—the same scenario in which the Board has recently confirmed that a PTAB trial was proper. *Mylan Pharm. Inc. v. Horizon Pharma USA, Inc.*, IPR2018-00272, Pap. 20, 6-8 (PTAB March 28, 2019) (“we need not necessarily determine the outer boundaries of a claim in reaching a conclusion as to whether
10 the asserted prior art anticipates a claim or renders it obvious”); EX1003, ¶65. As detailed below, Jones and Zelst teach LTSs with more subcarriers than used in 802.11a or 802.11g systems, and the evidence here confirms this recognizable overlap with the preferred embodiment of the ’842 patent. *Infra*, Sections VII.B,

⁴ POSITA would know that the number of subcarriers for carrying the training sequence is configured differently for different standards (*e.g.*, 52 subcarriers for 802.11a / 802.11g; 56 subcarriers for 802.11n). The intrinsic record is unclear as to whether, for example, the 802.11n system would be considered a “standard wireless networking configuration” under this claim. *See* EX1003, ¶65.

VIII.B, IX.C, X, and XI.B (analysis of element [1.d]); EX1003, ¶¶53, 64-69, 117, 137-139.

Regardless of which interpretation of this term is used here, the '842 patent is ripe for review in a full PTAB trial, especially where the prior art teaches
5 essentially the same disclosure (and the exact same “extended long training sequence”) as the preferred embodiment of the '842 patent.⁵

⁵ To be clear, the Petition sets forth alternative interpretations for this phrase along with an ample demonstration of the unpatentability of claims under each alternative interpretation, which is sufficient for institution of review. *General Electric*, Paper 9, 12-16; *Intel*, Paper 8, 11-13. Also, in cases where the outermost boundary of the claim scope is ambiguous, but the same preferred embodiment is recognized both in the specification and the prior art, the Board has held it is not paralyzed against assessing whether the claim encompasses the strikingly similar prior art structure for purposes of an anticipation/obviousness inquiry. *Mylan*, IPR2018-00272, Pap. 20, 6-8 (PTAB March 28, 2019) (“we need not necessarily determine the outer boundaries”). Indeed, this exact tribunal has compared ambiguous claims to the prior art for purposes of considering unpatentability. *Chicago Mercantile Exchange, Inc. v. 5th Market, Inc.*, CBM2013-00027, Paper

B. “a legacy wireless local area network device in accordance with a legacy wireless networking protocol standard” (claim 14)

According to a first interpretation, the phrase “a legacy wireless local area network device in accordance with a legacy wireless networking protocol

5 standard” means “wireless local area network device using an earlier version of a standard issued by a Standard Setting Organization (SSO) (for, example, IEEE or 3GPP).” Under this interpretation, the claim term encompasses the preferred embodiment of the ’842 patent, which states that the “inventive expanded long training sequence may be used by 802.11a or 802.11g devices.” EX1001, 4:6-8.

10 As detailed below, Jones and Zelst teach optimal extended long training sequences (ELTSs) that are longer than those used by at least one of 802.11a or 802.11g devices. *Infra*, Sections VII.B, VIII.B, IX.C, X, and XI.B (analysis of claim 14); EX1003, ¶¶53, 78-81, 117, 151-154.

33, 3 (PTAB 2014) (claims were both indefinite and obvious); *SAP America, Inc. v. Lakshmi Arunachalam*, CBM2013-00013, Paper 61, 29 (PTAB 2014). Also, the Federal Circuit does not forbid the Board from doing so. *In re Gee*, 614 Fed. Appx. 495, 497 (Fed. Cir. 2015) (finding no error in the PTAB decision, which compared the indefinite claims to the prior art for purposes of an obviousness analysis).

According to a second interpretation, the “legacy” claim phrase plainly encompasses at least the preferred embodiment in the specification, but the outermost boundaries of “legacy” are ambiguous for purposes of determining infringement. There is no dispute that, according to the preferred embodiment, the claim scope would encompass 802.11a- or 802.11g-compliant devices: “The inventive expanded long training sequence may be used by 802.11a or 802.11g devices...” EX1001, 4:7-9, 4:11-19, 1:50-2:7. Under this interpretation, although a POSITA would recognize that 802.11a and 802.11g-compliant devices fall within the scope of the claim (and are readily comparable to the prior art examples cited below), the outermost boundaries of a “legacy” wireless local area network device are neither defined nor clarified in the intrinsic record—the same scenario in which the Board has recently confirmed that a PTAB trial was proper. Mylan, IPR2018-00272, Pap. 20 at 6-8; EX1003, ¶79. As detailed below, Jones and Zelst teach optimal ELTSs that are longer than those used by 802.11a or 802.11g compliant devices, and the evidence here confirms this noticeable overlap with the preferred embodiment of the ’842 patent. *Infra*, Sections VII.B, VIII.B, IX.C, X, and XI.B (analysis of claim 14); EX1003, ¶¶53, 78-81, 117, 151-154.

For these reasons, the '842 patent is ripe for review in a full PTAB trial regardless of which alternative interpretation is used here.⁶

C. “extended long training sequence” (claims 1, 19)

According to a first interpretation, the phrase “extended long training
5 sequence” means “training sequence that uses more active subcarriers than an
earlier version of the same standard.” Under this interpretation, the claim term is
described at least by the preferred embodiment of the '842 patent, which states that
the “expanded long training sequence and the optimal expanded long training
sequence are stored on more than 52 sub-carriers.” EX1001, Abstract. As detailed
10 below, Jones and Zelst teach ELTSs that are stored on more than 52 subcarriers.
Infra, Sections VII.B, VIII.B, IX.C, X, and XI.B (analysis of claims 1, 19);
EX1003, ¶¶53, 56-58, 82, 83, 117, 121-125, 180.

According to a second interpretation, “extended long training sequence”
plainly encompasses at least the preferred embodiment in the specification, but the
15 outermost boundaries of the claim phrase are ambiguous for purposes of
determining infringement. There is no dispute that, according to the preferred
embodiment, the claim scope would encompass the LTS shown in Figure 5 of

⁶ *Supra*, footnote 5.

the '842 patent. EX1001, 5:20-25. Under this interpretation, although a POSITA would recognize that the LTS shown in Figure 5 falls within the scope of the claim (and is readily comparable to the same sequence cited in the prior art examples below), the outermost boundaries of an “extended long training sequence” are not defined or clarified in the intrinsic record—the same scenario in which the Board has recently confirmed that a PTAB trial was proper. *Mylan*, IPR2018-00272, Pap. 20 at 6-8; EX1003, ¶57. As detailed below, Jones and Zelst teach ELTSs carried on 63 subcarriers using identical ELTSs as shown in Figure 5 of the '842 patent. *Infra*, Sections VII.B, VIII.B, IX.C, X, and XI.B (analysis of claims 1, 19); EX1003, ¶¶53, 56-58, 82, 83, 117, 121-125, 180.

For these reasons, the '842 patent is ripe for review in a full PTAB trial regardless of which alternative interpretation is used here.⁷

D. “optimal extended long training sequence” (claims 1, 4, 14, 19)

According to a first interpretation, the phrase “extended long training sequence” means “training sequence with a minimal peak to average ratio.” Under this theory, the claim term is described at least by the preferred embodiment of the '842 patent, which states that “FIG. 5 illustrates the long training sequence with

⁷ *Supra*, footnote 5.

a minimum peak-to-average power ratio that is used in 63 active sub-carriers.”

EX1001, 5:20-25. As detailed below, Jones and Zelst each teach LTSs with a minimal peak-to-average ratio. *Infra*, Sections VII.B, VIII.B, IX.C, X, and XI.B

(analysis of claims 1, 4, 14, 19); EX1003, ¶¶60-62, 130-134. Indeed, both Jones

5 and Zelst teach the same “training sequence with a minimal peak to average ratio” that the ’842 patent discloses in its preferred embodiment in Figure 5. EX1003, ¶¶53, 117.

According to a second interpretation, “optimal extended long training sequence” plainly encompasses at least the preferred embodiment in the

10 specification, but the outermost boundaries of the claim phrase are ambiguous for purposes of determining infringement. There is no dispute that, according to the preferred embodiment, the claim scope would encompass the ELTS of Figure 5 of the ’842 patent “with a minimum peak-to-average power ratio.” EX1001, 5:20-25.

Under this interpretation, although a POSITA would recognize that the optimal

15 ELTS of Figure 5 falls within the scope of the claim (and is readily comparable to the identical sequence cited in the prior art examples below), the outermost

boundaries of an “optimal extended long training sequence” are not defined or clarified in the intrinsic record—the same scenario in which the Board has recently confirmed that a PTAB trial was proper. *Mylan*, IPR2018-00272, Pap. 20 at 6-8;

20 EX1003, ¶61. As detailed below, Jones and Zelst teach LTSs with minimal PAPR.

Infra, Sections VII.B, VIII.B, IX.C, X, and XI.B (analysis of claims 1, 4, 14, 19); EX1003, ¶¶6062, 130-134.

For these reasons, the '842 patent is ripe for review in a full PTAB trial regardless of which alternative interpretation is used here⁸

5 **VII. GROUND 1: CLAIMS 1, 2, 3, 4, 8, 11, 14, AND 19 ARE ANTICIPATED BY JONES**

A. Overview of Jones

 Jones (EX1004) discloses “[c]hannel estimation techniques ... for a receiver of a wireless communication system using orthogonal frequency division
10 multiplexing (OFDM).” EX1004, Abstract. Figure 3 shows a block diagram of the wireless communication system 300.

⁸ *Supra*, footnote 5.

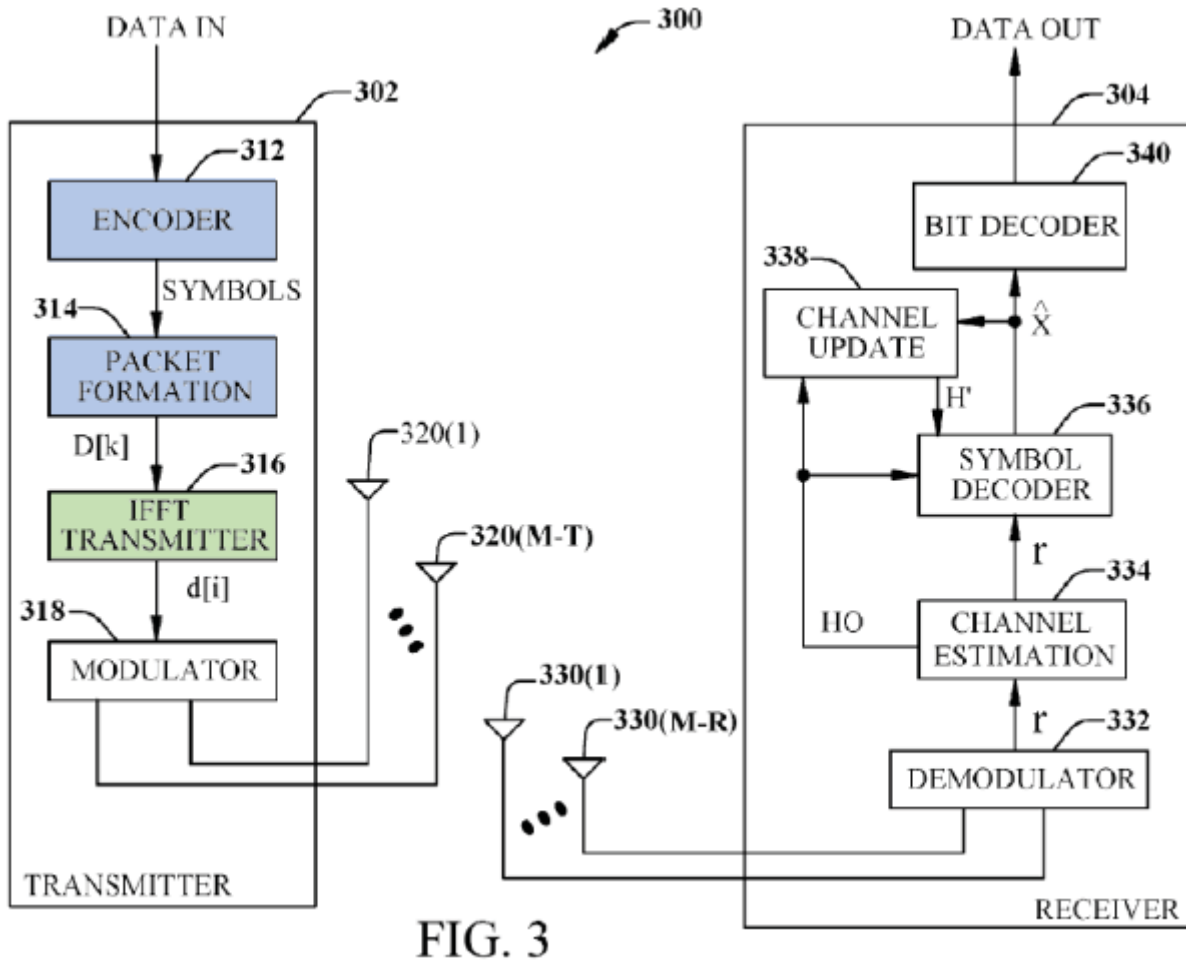


FIG. 3

EX1004, FIG. 3. (color added).

As Figure 3 shows, the system includes a transmitter and a receiver. *Id.*, 5:6-11. The transmitter includes “an encoding block 312 that receives an input data stream and encodes it into a sequence of symbols (complex values) to be transmitted, a packet formation block 312 that formats the encoded data into packets for transmission, an IFFT block 316 that applies the symbol data as modulation to a number of subcarriers, and a modulator block 318 that modulates the IFFT output according to a carrier frequency for transmission.” *Id.*, 5:11-20.

The packet formation block provides a group of symbols, $D[k]$ or $L[k]$, to IFFT block, which outputs time-domain samples, $d[i]$ or $l[k]$. *Id.*, 5:65-6:10, 7:50-67.

Jones teaches modifying an extended mode LTS, $L[k]$, to contain more than 52 non-zero subcarriers, such as sequences L_2 and L_3 of Figure 4, which both

5 include 63 non-zero subcarriers. *Id.*, 8:22-28. Significantly, as illustrated below, noting the different convention when listing the sequence,⁹ Jones teaches the exact same LTS (L_2 in Figure 4) shown in Figure 5 of the '842 patent, which the '842 patent teaches as having “a minimum peak to-average power ratio that is used in 63 active sub-carriers,” a PAPR of 3.6 dB. *Compare* EX1004, FIG. 4, with

10 EX1001, FIG. 5. Dr. Wells demonstrates this fact (EX1003, ¶¶39-45), which is also illustrated here:

$$L_2 = \{ \begin{matrix} 0 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & -1 & 1 & -1 & -1 & -1 & -1 & 1 & 1 \\ 16 & 17 & 18 & 19 & 20 & 21 & 22 & 23 & 24 & 25 & 26 & 27 & 28 & 29 & 30 & 31 \\ -1 & -1 & 1 & 1 & 1 & 1 & 1 & 1 & -1 & -1 & 1 & 1 & 1 & 1 & -1 & -1 \\ -32 & -31 & -30 & -29 & -28 & -27 & -26 & -25 & -24 & -23 & -22 & -21 & -20 & -19 & -18 & -17 \\ 16 & 15 & 14 & 13 & 12 & 11 & 10 & 9 & 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 \end{matrix} \}$$

⁹ As illustrated in the annotated L_2 sequence above, Jones discloses that the sequence is listed from index 0 to 31 followed by index -32 to -1. EX1004, 2:14-30, 8:24-28. The '842 patent uses a different convention, listing the sequence from index -32 to +31. EX1001, FIG. 5; EX1003, ¶¶39-45.

EX1004, FIG. 4 (excerpted, annotated).

-1	-1	+1	+1	+1	+1	1	1	-1	-1	1	1	-1	1	-1	1	1	1
-32	-31	-30	-29	-28	-27	-26	-25	-24	-23	-22	-21	-20	-19	-18	-17	-16	-15

Sub-carrier index

1	1	1	-1	-1	1	1	-1	1	-1	1	1	1	1	0
-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0

Sub-carrier index

+1	-1	-1	1	1	-1	1	-1	1	-1	-1	-1	-1	-1
1	2	3	4	5	6	7	8	9	10	11	12	13	14

Sub-carrier index

1	1	-1	-1	1	-1	1	-1	1	1	1	1	-1	-1	-1	+1	-1
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

Sub-carrier index

EX1001, FIG. 5.

B. Anticipated by Jones

5 As explained above in Section VII.A, Jones discloses a wireless communication system with a transmitter that includes encoding and packet formation blocks that together encode symbols and format data into packets for transmission and an IFFT block that applies the symbol data as modulation to a number of subcarriers. EX1004, 5:5-16, 6:1-10. Jones also discloses the same

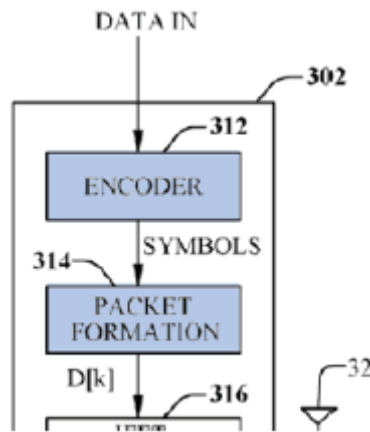
10 LTS used in 63 active subcarriers that the '842 patent teaches as achieving the minimum PAPR. *Id.*, FIG. 4.

[1.P] A wireless communications device, comprising:

To the extent the preamble is limiting, Jones discloses this element. *Id.*, 5:5-22, FIG. 3; EX1003, ¶55. For example, Jones discloses a “MIMO communication system 300” that includes “**a transmitter system 302** and a receiver system 304 communicating via a channel 306.” *Id.* Jones discloses that the system can be implemented in conventional 802.11a communications as well as in “various extended rate 802.11a-based systems and other **wireless communications systems using OFDM.**” *Id.*, 4:65-5:3.

[1.a] a signal generator that generates an extended long training sequence; and

Jones discloses this element. EX1003, ¶¶56-58. For example, Jones teaches that the transmitter system includes “an **encoding block 312** that receives an input data stream and encodes it into a sequence of symbols (complex values) to be transmitted” and “a **packet formation block 312** that formats the encoded data into packets for transmission.” *Id.*, 5:11-15.



EX1004, FIG. 3 (excerpted, color added).

Jones teaches that “input data is provided (generally as a bit stream) to encoder 312, which encodes the data stream into a sequence of complex numbers (symbols).” *Id.*, 5:41-43. The encoding “may include forward error correction (FEC) encoding ..., bit interleaving, and mapping groups of bits to symbols in a signaling constellation” using, *e.g.*, BPSK.” *Id.*, 5:43-51. The symbols are then provided to the “packet formation block 314, which groups the symbols into packets for transmission.” *Id.*, 5:58-60. The packet formation block “may also add additional symbols into the data stream, such as a conventional IEEE 802.11a preamble ... or a modified IEEE 802.11a preamble.” *Id.*, 5:60-64.

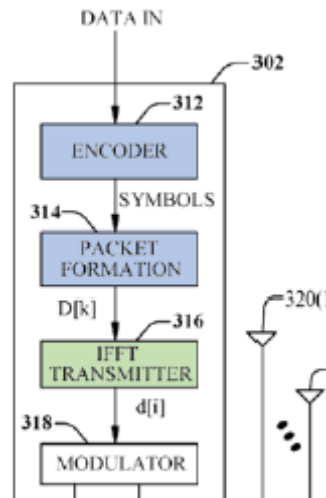
While the outermost boundaries of the term “extended long training sequence” are subject to alternative interpretations (Section VI), there is no dispute this element plainly encompasses at least the preferred embodiment of the ’842 patent shown in Figure 5. EX1001, 5:20-25. Jones clearly teaches the same ELTS

as is disclosed as the preferred embodiment in the '842 patent. EX1004, FIG. 4; *supra*, pp. 26-27. Jones teaches that the packet formation block “advantageously prepends a preamble to each transmitted packet,” which may include “a preamble suitable for extended-rate 802.11a communication systems.” *Id.*, 7:38-42. Jones
5 discloses that in “a legacy 802.11a packet,” long training symbol $L[k]$ may “contain 64 subcarrier values, of which 52 are non-zero.” *Id.*, 8:10-13. Jones discloses that in “an ***extended mode long training sequence***,” $L[k]$ may “contain more than 52 non-zero subcarriers,” such as sequence L2 in Figure 4. *Id.*, 8:22-28, 4:39-40, FIG. 4. Thus, the encoder and packet formation blocks of Jones are
10 collectively a signal generator that generates an ELTS (*e.g.*, $D[k]$, $L[k]$).

[1.b] an Inverse Fourier Transformer operatively coupled to the signal generator,

Jones discloses this element. EX1003, ¶59. Jones teaches that the transmitter system includes “an ***IFFT (inverse Fast Fourier Transform)*** block
15 316 that applies the symbol data as modulation to a number of subcarriers,” and further explains that the “functional blocks ... may be implemented using hardware (*e.g.*, suitable integrated circuit components), software (*e.g.*, program instructions) executing on appropriate processing devices.” EX1004, 5:10-19, 20:26-34.

Additionally, Jones discloses that the IFFT transforms frequency domain samples
20 (*e.g.*, $D[k]$) to the time domain (*e.g.*, $d[i]$). *Id.*, 2:31-39, 5:67-6:10, 8:10-20.



EX1004, FIG. 3 (excerpted, color added).¹⁰

As illustrated in Figure 3 of Jones, the IFFT transmitter is operatively coupled to the signal generator (collectively, encoder and packet formation

5 blocks). *Id.*, FIG. 3. Moreover, Jones teaches that “[p]acket formation block 314

¹⁰ Petitioners have offered a construction for the term “Inverse Fourier Transformer” in the district court (EX1012, 5), but this term does not require a formal construction by the Board because each of the prior art cited herein expressly describe a conventional Inverse Fourier Transformer (*e.g.*, “IFFT”) under any construction proposed in district court. *Wellman*, 642 F.3d at 1361 (“claim terms need only be construed to the extent necessary to resolve the controversy”).

provides groups of symbols to IFFT module 316, which uses the groups of symbols to modulate a group of OFDM subcarriers.” *Id.*, 5:65-67.

5 **[1.c] wherein the Inverse Fourier Transformer processes the extended long training sequence from the signal generator and provides an optimal extended long training sequence with a minimal peak-to-average ratio, and**

Jones discloses this element. EX1003, ¶¶60-63. Jones teaches that the “IFFT module 316 generates 64 time-domain samples $d[i]$ ” from ELTS $D[k]$ using the equation:

$$d[i] = \sum_{k=0}^{63} D[k] \exp \left(j \frac{2\pi i k}{64} \right).$$

10 EX1004, 5:67-6:10.

While the outermost boundaries of the claim term “optimal extended long training sequence” are subject to alternative interpretations (Section VI), there is no dispute this element plainly encompasses at least the preferred embodiment of the ’842 patent: “FIG 5 illustrates the long training sequence with a minimum peak-to-average power ratio[.]” EX. 1001, 5:20-21. Jones teaches the L2 sequence, which is identical to the LTS in Figure 5 of the ’842 patent. *Id.*, FIG. 4, 8:22-28; *supra*, pp. 26-27. A POSITA would have recognized that Jones’ IFFT module performs the same IFFT function as the Inverse Fourier Transformer of the ’842 patent, thus yielding the same output as in the ’842 patent. EX1003, ¶62.

15

20

While Jones does not explicitly teach that the L2 sequence achieves the minimal PAPR of “3.6 dB,” this characteristic of the L2 sequence was inherent in Jones. To establish inherency, one may rely on extrinsic evidence that “make[s] clear that the missing descriptive matter is necessarily present in the thing
5 described in the reference, and that it would be so recognized by persons of ordinary skill.” *Continental Can Co. USA v. Monsanto Co.*, 948 F.2d 1264, 1268, (Fed. Cir. 1991). Furthermore, as long as there is evidence of record establishing inherency, failure of those skilled in the art to contemporaneously recognize an inherent property, function or ingredient of a prior art reference does not preclude a
10 finding of anticipation. *Atlas Powder Co. v. IRECO, Inc.*, 190 F.3d 1342, 1349 (Fed. Cir. 1999). Indeed, the Federal Circuit noted the basis for the inherent anticipation doctrine by recognizing that “the discovery of a previously unappreciated property of a prior art composition, or of a scientific explanation for the prior art’s functioning, does not render the old composition patentably new to
15 the discoverer.” *See id.*, 1347.

As shown above in Section VII.A, Jones’ L2 sequence is ***identical*** to the ELTS that the ’842 patent teaches as having “***the minimum peak-to-average power ratio, i.e., a peak-to-average power ratio of 3.6 dB.***” EX1001, 5:20-25; *supra*, pp. 26-27. That Jones did not explicitly state that the sequence L2 provided
20 the “optimal” sequence with the “minimum peak-to-average power ratio of 3.6 dB”

does not preclude Jones from inherently anticipating this characteristic of L2—

especially where Jones' L2 sequence is the same ELTS that the '842 patent

admitted will provide this same result. Moreover, the extrinsic evidence “makes

clear that the missing descriptive matter is necessarily present in the thing

5 described in the reference, and that it would be so recognized by persons of

ordinary skill.” *Continental*, 948 F.2d at 1268; EX1003, ¶62; EX1001, 5:2-25

(admitting this resulting characteristic of the same L2 sequence). It is well settled

law that an inherent feature need not be recognized by a POSITA at the time of the

invention. *Schering Corp. v. Geneva Pharmaceuticals, Inc.*, 339 F.3d 1373, 1377

10 (Fed. Cir. 2003). Rather, the only requirement is that the subject matter is in fact

inherent in the prior art reference. *Id.* The evidence herein confirms Jones' L2

sequence provides this same result.

**[1.d] wherein at least the optimal extended long training sequence is carried by
a greater number of subcarriers than a standard wireless networking
15 configuration for an Orthogonal Frequency Division Multiplexing
scheme.**

Jones discloses this element. EX1003, ¶¶64-69. Jones discloses that in “a
legacy 802.11a packet, one 3.2 microsecond repetition of the long training symbol

L is expressed in the time domain as the IFFT of L1[k], where L1[k] contains 64

20 subcarrier values, of which 52 are non-zero.” EX1004, 6:11-14. In contrast to an

802.11a packet which has only 52 non-zero subcarriers, Jones teaches an extended

mode LTS (*e.g.*, L2 of Figure 4) that “can contain more than 52 non-zero subcarriers.” *Id.*, 6:22-29. Additionally, Jones teaches performing an IFFT on the extended mode LTS L2 to generate an output using the equation

$$l[i] = \sum_{k=0}^{63} L[k] \exp\left(j \frac{2\pi i k}{64}\right).$$

Id., 6:1-7, 8:10-20. A POSITA would have recognized that performing an IFFT on L2 (with 63 active subcarriers) would yield an optimal ELTS with 63 subcarriers. EX1003, ¶66.

While the outermost boundaries of the claim term “a standard wireless networking configuration for an Orthogonal Frequency Division Multiplexing scheme” are subject to alternative interpretations (Section VI), there is no dispute this element plainly encompasses at least the preferred embodiment of the ’842 patent—where “only 52 of the 64 active subcarriers are used” in “802.11a and 802.11g compliant devices,” but the ’842 patent’s “optimal expanded long training sequence may be used in ... 63 [subcarriers]. EX1001, 2:14-16, 4:59-61; EX1003, ¶¶65-66. Jones clearly teaches such an optimal ELTS with 63 subcarriers, which is more than the 52 subcarriers in an 802.11a/g system for an OFDM scheme.

[2] The wireless communications device according to claim 1, wherein at least the optimal extended long training sequence is carried by at least 56 active sub-carriers.

As discussed with respect to element [1.d], Jones discloses that at least the

5 optimal ELTS is carried by 63 active subcarriers, which is at least 56 active subcarriers. EX1003, ¶70; EX1004, 6:11-14, 6:22-29, 6:1-7, 8:10-20.

[3] The wireless communications device according to claim 2, wherein the at least 56 active sub-carriers correspond to at least indexed sub-carriers -28 to +28.

10 Jones discloses that the at least 56 active sub-carriers correspond to at least indexed sub-carriers -28 to +28. EX1003, ¶¶71-73. As discussed with respect to claim 2, Jones teaches ELTS L2 that is input into the IFFT, which generates an output $l[i]$. *Id.*, 6:10-29, FIG. 4. A POSITA would have recognized that using sequence L2 as an input would result in an output $l[i]$ having 63 non-zero
15 subcarriers, which correspond to indexed subcarriers -32 to -1 and 1 to +31. EX1003, ¶¶71-72. Thus, using ELTS L2 as an input, the IFFT module outputs a sequence in the time domain corresponding to at least indexed sub-carriers -28 to +28.

[4] ***The wireless communications device according to claim 2, wherein the optimal extended long training sequence has a minimum peak-to-average power ratio of 3.6 dB.***

As discussed with respect to element [1.c], Jones discloses that the optimal

5 ELTS has a minimum PAPR of 3.6 dB. EX1003, ¶74; EX1004, 5:67-6:10; EX1001, 5:20-25, 8:22-28, FIG. 4.

[8] ***The wireless communications device according to claim 1, wherein a binary phase shift key encoding is used for each sub-carrier above the +26 indexed sub-carrier and below the -26 indexed sub-carrier.***

10 Jones discloses this element. EX1003, ¶¶75-76. Jones teaches sequence L2 (see EX1003, ¶75 (illustrated with annotated FIG. 4 from EX1004)), which shows that the value of each subcarrier above the +26 indexed subcarrier and below the 26 indexed subcarrier is either -1 or 1, so BPSK encoding was used for each subcarrier value. EX1003, ¶75.

15 [11] ***The wireless communications device according to claim 1, wherein the wireless communications device comprises a wireless mobile communications device.***

Jones discloses this element. EX1003, ¶77. Jones teaches that the transmitter system can be a “**mobile** transmitter system 302.” See EX1004, 7:12-

20 15. Additionally, Jones’ system can be implemented “with any number of transmit antennas and any number of receive antennas, some or all of which might be **mobile**.” *Id.*, 20:18-21.

[14] ***The wireless communications device according to claim 1, wherein the optimal extended long training sequence is longer than a long training***

sequence used by a legacy wireless local area network device in accordance with a legacy wireless networking protocol standard.

Jones discloses this element. EX1003, ¶¶78-81. As discussed with respect to claim 2, the optimal ELTS that Jones' L2 sequence provides is carried by 63 active subcarriers. Jones discloses that "[i]n an extended mode long training sequence, $L_1[k]$ may be modified" to "contain more than 52 non-zero subcarriers." EX1004, 8:22-24. Examples of "long training sequences with additional non-zero subcarriers" are shown in Figure 4 of Jones as L2 and L3. *Id.*, 8:24-28, FIG. 4.

While the outermost boundaries of the term "a legacy wireless local area network device in accordance with a legacy wireless networking protocol standard" are ambiguous, the term plainly encompasses at least the preferred embodiment of the '842 patent—that is, 802.11a or 802.11g compliant devices.

EX1001, 4:6-8; EX1003, ¶79. Jones clearly teaches wherein the optimal ELTS is longer than an LTS used by 802.11a or 802.11g compliant devices. Jones' L2 sequence is carried out by 63 active subcarriers—longer than the 52 non-zero subcarriers used by a 802.11a or 802.11g devices.

[19] The wireless communications device according to claim 1, wherein the extended long training sequence or the optimal extended long training

sequence is encoded using binary phase shift key encoding on each of the subcarriers.

Jones discloses this element. EX1003, ¶¶82-83. Figure 4 of Jones shows that ELTS L2 is encoded using BPSK encoding on each of the active subcarriers because each value is either -1 or 1. EX1004, FIG. 4; *supra*, pp. 26-27.

While the outermost boundaries of the term “extended long training sequence” are subject to alternative interpretations (Section VI), there is no dispute this element plainly encompasses at least the preferred embodiment of the ’842 patent shown in Figure 5. EX1001, 5:20-25; EX1003, ¶83. As the ’842 patent explains, “[t]he long training sequence of 802.11a and 802.11g is defined such that each of sub-carriers -26 to +26 has one BPSK constellation[sic] point, either +1 or 1.” EX1001, 2:29-35. A POSITA would have recognized that BPSK encoding is applied to each active subcarrier in the LTS (all non-zero subcarriers) L2 of Jones, which is identical to the preferred embodiment of the ’842 patent. EX1003, ¶¶53, 83. Thus, Jones discloses that the ELTS or the optimal ELTS is encoded using BPSK encoding on each of the subcarriers.

VIII. GROUND 2: CLAIMS 1, 2, 3, 4, 8, 11, 14, AND 19 ARE OBVIOUS IN VIEW OF JONES AND KHANDANI

As discussed in Section VII, Jones discloses a wireless communication system with a transmitter that includes an encoding block 312 and packet formation block 314 that generate ELTSs and an IFFT block 316 that outputs time

domain sequences. See EX1004, 5:5-16, 6:1-10. While Jones teaches the same LTS used in 63 active subcarriers as taught by the '842 patent (*supra*, pp. 26-27) to result in the minimum PAPR, Jones does not explicitly teach that sequence L2 provides the “optimal extended long training sequence with a minimal peak-to-average ratio” (element [1.c]) or that the minimal PAPR is “3.6 dB” (claims 4, 7). To the extent that these characteristics of Jones’ L2 sequence are not inherent (which they are), the predictable combination of Jones and Khandani teaches these features.

A. Overview of Khandani

Khandani is directed to an OFDM transmitter with constellation shaping and a PAPR reduction algorithm performed for subcarriers. *Id.*, [0086], [0088]. According to Khandani, certain permutations of constellation points can have disadvantages that result in “high peak power in the multi-tone signal.” *Id.*, [0005]. Other “permutations of constellation points ... result in a low peak power in the multi-tone signal.” *Id.*

To address the disadvantages, Khandani teaches a method of selecting constellation points that result in a reduced PAPR, shown in Figure 3. EX1005, [0057], [0082], FIG. 3. Khandani teaches “evaluating the peak average power ratio for all the possible permutations (step 3-1) and then searching through all possible permutations of choices of constellation points for a set of constellation

points which will result in the smallest possible peak average power ratio (step 3-2).” EX1005, [0082].

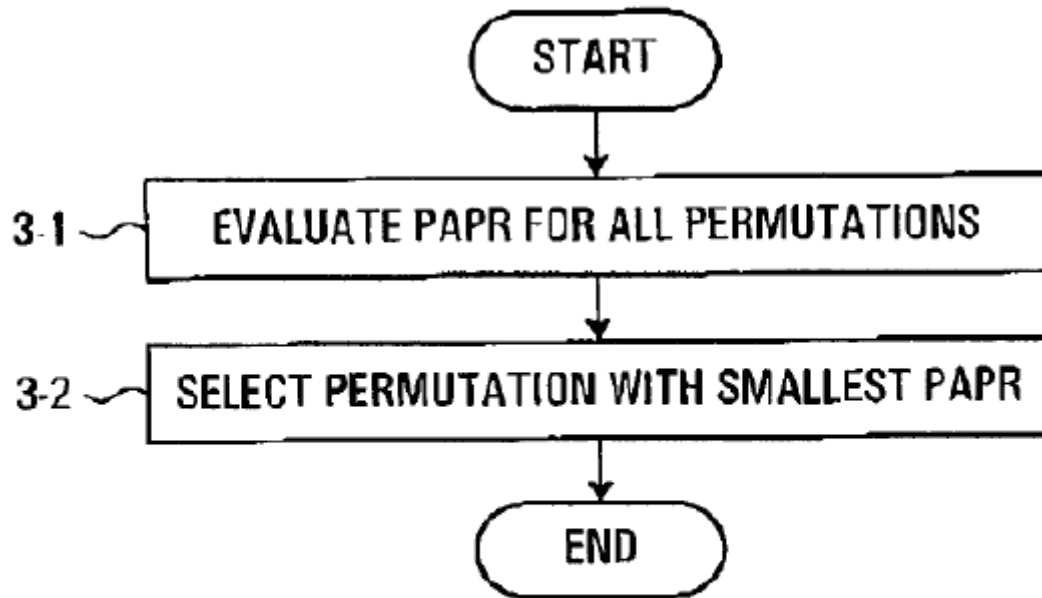


FIG. 3

EX1005, FIG. 3.

5 **B. Obviousness in view of Jones and Khandani**

As explained above in Section VII, Jones discloses a wireless communication system with an encoder block 312, packet formation block 314, and an IFFT block. EX1004, 5:5-16, 6:1-10. Jones further discloses the same LTS used in 63 active subcarriers that the '842 patent teaches as achieving the minimum PAPR. *Id.*, FIG. 4. As explained in Section VIII.A, Khandani is directed to an

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OFDM transmitter and plainly suggests selecting constellation points that result in a reduced PAPR. EX1005, [0057], [0082], [0088], FIG. 3.

For the reasons articulated below, it would have been obvious to a POSITA to implement Jones' transmitter system (which generates ELTSs) based on

5 Khandani's suggestion for selecting permutations of the ELTSs in order to achieve a minimal PAPR. EX1003, ¶89.

[1.P] A wireless communications device, comprising:

As discussed in Section VII.B (element [1.P]), Jones teaches this element. EX1004, FIG. 3, 4:65-5:3, 5:5-22; EX1003, ¶90.

10 ***[1.a] a signal generator that generates an extended long training sequence; and***

As discussed in Section VII.B (element [1.a]), Jones teaches this element. EX1004, 4:39-40, 5:11-15, 5:41-51, 5:58-64, 7:38-42, 8:10-13, 8:22-28, FIGs. 3-4; EX1001, 5:20-25; EX1003, ¶91.

15 ***[1.b] an Inverse Fourier Transformer operatively coupled to the signal generator,***

As discussed in Section VII.B (element [1.b]), Jones teaches this element. EX1004, 2:31-39, 5:10-19, 5:65-6:10, 8:10-20, 20:26-34, FIG. 3; EX1003, ¶92.

[1.c] wherein the Inverse Fourier Transformer processes the extended long training sequence from the signal generator and provides an optimal

extended long training sequence with a minimal peak-to-average ratio, and

As discussed in Section VII.B (element [1.c]), Jones teaches the same ELTS (*supra*, pp. 26-27) that the '842 patent teaches as having “the minimum peak-to average power ratio, i.e., a peak-to-average power ratio of 3.6 dB.” EX1004, 5:676:10, 8:22-28, FIG. 4 (L2); EX1001, FIG. 5, 5:20-25; EX1003, ¶¶93-97. To the extent that Jones does not teach these specific characteristics of L2, Khandani suggests it was conventional to select an LTS that would achieve a minimal PAPR. EX1003, ¶¶94-97. As shown in Figure 3, Khandani teaches “evaluating the peak average power ratio for all the various permutations” and “searching through all possible permutations of choices” to select the selecting the permutation that “will result in the smallest possible peak average power ratio.” EX1005, [0082], FIG. 3.

The evidence here shows multiple reasons existed that would have prompted a POSITA to implement the transmitter system of Jones (including a signal generator (encoding block 312, packet formation block 314) and an inverse Fourier Transformer (IFFT 316) and ELTS L2 of Jones (L2 of Figure 4) based on Khandani's express suggestion (for selecting the permutation that results in the smallest possible PAPR). **First**, such a predictable implementation of Jones would have advantageously confirmed that Jones had achieved a system in which Jones' L2 sequence provided the desired minimal PAPR among the possible

permutations. EX1003, ¶97. As previously detailed, the L2 sequence of Jones includes more than 52 non-zero subcarriers—specifically, 11 additional subcarriers. See EX1004, 8:23-24, FIG. 4. Thus, a POSITA would have been motivated to evaluate the various permutations to select the sequence L2 and
5 determine that the L2 sequence achieved the smallest possible PAPR (*e.g.*, 3.6 dB). EX1003, ¶97. **Second**, doing so would have been merely the application of a known technique (*e.g.*, selecting the permutation that results in the smallest possible PAPR) to a known system (Jones’ transmitter system) ready for improvement to yield predictable results. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S.
10 398, 417 (2007). Indeed, the ’842 patent admitted that employing the same ELTS as Jones’ L2 sequence would result in “the minimum peak-to-average power ratio, i.e., a peak-to-average power ratio of 3.6 dB.” Compare EX1001, FIG. 5, 5:20-25, with EX1004, FIG. 4 (L2). A POSITA would have recognized that applying Khandani’s suggestion to Jones’ system would have led to predictable results
15 without significantly altering or hindering the functions performed by the system of Jones. EX1003, ¶97.

[1.d] wherein at least the optimal extended long training sequence is carried by a greater number of subcarriers than a standard wireless networking

configuration for an Orthogonal Frequency Division Multiplexing scheme.

As discussed in Section VII.B (element [1.d]), Jones teaches this element.

EX1004, 6:1-7, 6:11-14, 6:22-29, 8:10-20; EX1001, 2:14-16, 4:59-61; EX1003,

5 ¶97.

[2] The wireless communications device according to claim 1, wherein at least the optimal extended long training sequence is carried by at least 56 active sub-carriers.

As discussed in Section VII.B (claim 2), Jones teaches this claim. EX1004,

10 6:1-7, 6:11-14, 6:22-29, 8:10-20; EX1001, 2:14-16, 4:59-61; EX1003, ¶99.

[3] The wireless communications device according to claim 2, wherein the at least 56 active sub-carriers correspond to at least indexed sub-carriers –28 to +28.

As discussed in Section VII.B (claim 3), Jones teaches this claim. EX1004,

15 6:10-29, FIG. 4; EX1003, ¶100.

[4] The wireless communications device according to claim 2, wherein the optimal extended long training sequence has a minimum peak-to-average power ratio of 3.6 dB.

As discussed in Section VIII.B (element [1.c]), Jones teaches this claim.

20 EX1004, 8:23-24, FIG. 4 (L2); EX1001, FIG. 5, 5:20-25; EX1005, [0082], FIG. 3;

EX1003, ¶101.

[8] The wireless communications device according to claim 1, wherein a binary phase shift key encoding is used for each sub-carrier above the +26 indexed sub-carrier and below the -26 indexed sub-carrier.

As discussed in Section VII.B (claim 8), Jones teaches this claim. EX1004,

5 FIG. 4; EX1003, ¶102.

[11] The wireless communications device according to claim 1, wherein the wireless communications device comprises a wireless mobile communications device.

As discussed in Section VII.B (claim 11), Jones teaches this claim. EX1004,

10 7:12-15, 20:18-21; EX1003, ¶103.

[14] The wireless communications device according to claim 1, wherein the optimal extended long training sequence is longer than a long training sequence used by a legacy wireless local area network device in accordance with a legacy wireless networking protocol standard.

15 As discussed in Section VII.B (claim 14), Jones teaches this claim. EX1004, 8:22-28; EX1001, 4:6-8; EX1003, ¶104.

[19] The wireless communications device according to claim 1, wherein the extended long training sequence or the optimal extended long training sequence is encoded using binary phase shift key encoding on each of the subcarriers.

20 As discussed in Section VII.B (claim 19), Jones teaches this claim. EX1004, FIG. 4; EX1001, 2:29-35, 5:20-25, FIG. 5; EX1003, ¶105.

IX. GROUND 3: CLAIMS 1, 2, 3, 4, 8, 11, 14, AND 19 ARE OBVIOUS OVER IEEE IN VIEW OF ZELST

A. Overview of IEEE

IEEE (EX1007) is a publication titled “IEEE Std 802.11a-1999” that
5 published on December 30, 1999, and the evidence here confirms IEEE was
sufficiently and publicly accessible to interested members of the public no later
than March 20, 2000. EX1001, 1; EX1015, ¶¶5-8 (“from the Michigan State
University library”); *see also Ericsson, Inc. v. Intellectual Ventures I LLC*,
IPR2014-00527, Pap. 41, 10–11 (PTAB May 18, 2015) (“IEEE is a well-known,
10 reputable compiler and publisher of scientific and technical publications, and we
take Official Notice that”).

IEEE is directed to OFDM network systems, generally, including an OFDM
transmitter with various components. EX1007, 11, 32, FIG. 118. FIG. 118
(below) shows a transmitter, including an FEC encoder, an interleaving and
15 mapping block, and IFFT block. *Id.* at FIG. 118.

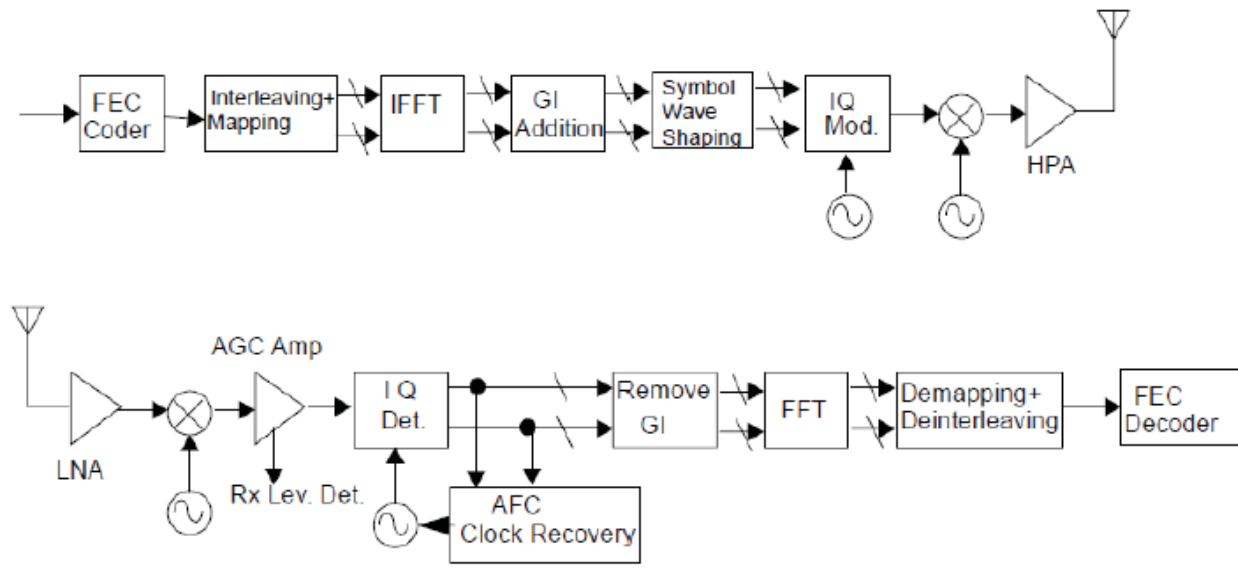


Figure 118—Transmitter and receiver block diagram for the OFDM PHY

EX1007, FIG. 118.

Additionally, IEEE discloses generating a “long OFDM training sequence of 53 subcarriers (including a zero value at dc)”:

$$L_{-26,26} = \{1, 1, -1, -1, 1, 1, -1, 1, -1, 1, 1, 1, 1, 1, -1, -1, 1, 1, -1, 1, -1, 1, 1, 1, 0, \\ 1, -1, -1, 1, 1, -1, 1, -1, 1, -1, -1, -1, -1, -1, 1, 1, -1, -1, 1, -1, 1, 1, 1, 1\}$$

Id., 21.

B. Overview of Zelst

Zelst (EX1006) was filed May 26, 2005, published December 29, 2005, and claims priority to the ’608 Provisional (EX1009), filed May 27, 2004. Zelst qualifies as prior art under 35 U.S.C. §102(e) on the basis of its provisional priority date under *Dynamic Drinkware*, 800 F.3d at 1375 and *Amgen v. Sanofi*, 872 F.3d

1367 (Fed. Cir. 2017). Here, the '608 Provisional application provides clear and unambiguous support for at least claim 1 of Zelst. EX1003, ¶182. To illustrate, the following table identifies exemplary support in the '608 Provisional application for each limitation of Zelst's independent claim 1, and the testimony of Dr. Wells confirms this fact:

<u>Claim Limitation (Zelst, Claim 1)</u> <u>(EX1006)</u>	<u>Exemplary Support ('608 Prov.)</u> <u>(EX1009)</u>
A training sequence comprising:	1:15-18, 2; <i>see also</i> 3, 8, 10, 12
at least first and second preambles configured respectively for transmission from at least first and second transmit antennas of a wireless communication system;	2; <i>see also</i> 3, 8, 10, 12
each of the at least first and second preambles further comprising: a short training sequence field	2 ("Short Sym"); <i>see also</i> 3, 8, 10, 12
a guard interval field;	2 ("GI2"); <i>see also</i> 3, 8, 10, 12
a long training sequence field; and	2 ("ELT"); <i>see also</i> 3, 8, 10, 12
a signal field;	2 ("SIG N"); <i>see also</i> 3, 8, 10, 12
wherein the short training sequence field of the second preamble has a cyclic shift with respect to the short training sequence field of the first preamble;	2 ("0ns cs"; "400ns cs"); <i>see also</i> 3, 8, 10, 12

wherein the long training sequence field of the second preamble has a cyclic shift; and	2 (“0ns cs”; “1600ns cs”); <i>see also</i> 3, 8, 10, 12
wherein the signal field of the second preamble has a cyclic shift with respect to the signal of the first preamble.	2 (“0ns cs”; “1600ns cs”); <i>see also</i> 3, 8, 10, 12

EX1003, ¶182. The ’608 Provisional also provides written description support for each of the portions of Zelst cited in this petition. EX1003, ¶183.

Substantively, Zelst discloses a “modified preamble” for use by “extended devices that operate at higher rates, MIMO or other extensions relative to strict 802.11a-compliant devices.” EX1006, Abstract. Zelst also teaches the same 52 subcarriers OFDM training sequence that IEEE discloses. *Id.*, [0017], FIG. 2.

Figure 15A of Zelst discloses a 64-tone ELTS 1200 adapted for a 20 MHz channel, where “energy is transmitted on every single tone except the DC tone.” *Id.*, [0106]. As illustrated below, and much like Jones, Zelst teaches **the same LTS** (L2 in Figure 4; Figure 15)¹¹ as the preferred embodiment (FIG. 5) of the ’842

¹¹ As with Jones’ L2 sequence, Zelst’s L2 sequence is also listed from index 0 to 31 followed by index -32 to -1. EX1006, [0007], [0106]. Zelst specifically recognizes that the L2 sequence is the same as the sequence of Figure 15A “except

patent, which the '842 patent admits would result in “a minimum peak to-average power ratio that is used in 63 active sub-carriers,” a PAPR of 3.6 dB. *Compare* EX1006, FIG. 15A, with EX1001, FIG. 5, 5:20-25. Dr. Wells demonstrates this fact (EX1003, ¶¶111-117), which is also illustrated here:

$$L2 = \begin{Bmatrix} 0 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & -1 & 1 & -1 & -1 & -1 & -1 & -1 & 1 \\ 1 & -1 & -1 & 1 & -1 & 1 & -1 & 1 & 1 & 1 & 1 & -1 & -1 & -1 & 1 & -1 \\ -1 & -1 & 1 & 1 & 1 & 1 & 1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & -1 & 1 \\ 1 & 1 & 1 & 1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & -1 & 1 & 1 & 1 & 1 \end{Bmatrix}$$

EX1006, FIG. 4 (excerpted).

$$\begin{Bmatrix} -1, & -1, & 1, & 1, & 1, & 1, & 1, & 1, & -1, & -1, & 1, & 1, & -1, & 1, & -1, & 1, \\ 1, & 1, & 1, & 1, & 1, & -1, & -1, & 1, & 1, & -1, & 1, & -1, & 1, & 1, & 1, & 1, \\ 0, & 1, & -1, & -1, & 1, & 1, & -1, & 1, & -1, & 1, & -1, & -1, & -1, & -1, & -1, & 1, \\ 1, & -1, & -1, & 1, & -1, & 1, & -1, & 1, & 1, & 1, & 1, & -1, & -1, & -1, & 1, & -1, \end{Bmatrix}$$

EX1006, FIG. 15A (excerpted).

that the DC tone in sequence is disposed at the beginning of the sequence.” *Id.*, [0106]. The '842 patent uses the same convention as Zelst’s Figure 15A, listing the sequence from index -32 to +31. EX1001, FIG. 5; EX1003, ¶¶39-45. For ease of comparison, the analysis herein is focused on Figure 15A.

-1	-1	+1	+1	+1	+1	1	1	-1	-1	1	1	-1	1	-1	1	1	1
-32	-31	-30	-29	-28	-27	-26	-25	-24	-23	-22	-21	-20	-19	-18	-17	-16	-15

Sub-carrier index

1	1	1	-1	-1	1	1	-1	1	-1	1	1	1	1	0
-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0

Sub-carrier index

+1	-1	-1	1	1	-1	1	-1	1	-1	-1	-1	-1	-1	-1
1	2	3	4	5	6	7	8	9	10	11	12	13	14	

Sub-carrier index

1	1	-1	-1	1	-1	1	-1	1	1	1	1	-1	-1	-1	+1	-1
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

Sub-carrier index

EX1001, FIG. 5 (excerpted)

C. Obviousness in view of IEEE and Zelst

As explained above in Section IX.A, IEEE is directed to OFDM wireless networks and discloses a transmitter that includes FEC encoder, interleaving and mapping block, and IFFT block. EX1007, FIG. 118. IEEE further discloses generating a long OFDM training sequence. EX1007, 21. As explained in Section IX.B, Zelst is directed to 802.11a-compliant devices and expressly suggests using the same LTS (with 63 active subcarriers) as that of the '842 patent (which admittedly results in achieving the minimum PAPR). EX1006, FIG. 15A.

IEEE and Zelst are both directed to wireless communications devices. As further discussed below, it would have been obvious to a POSITA to combine IEEE's transmitter for generating LTSs with Zelst's suggestion (LTSs for extended

devices including Zelst's ELTS of Figure 15A) to allow IEEE's transmitter to achieve increased data transmission. EX1003, ¶118; see EX1006, [0009].

[1.P] A wireless communications device, comprising:

To the extent the preamble is limiting, IEEE discloses the recited wireless communications device. EX1007, 11, 32, FIG. 118; EX1003, ¶120. IEEE discloses an "OFDM system that provides a wireless LAN with data payload communication capabilities" including a "transmitter." *Id.*, 11, 32.

[1.a] a signal generator that generates an extended long training sequence; and

IEEE discloses this element. EX1003, ¶¶121-125. For example, IEEE discloses that a "long OFDM training symbol shall be generated according to" a particular equation and further teaches "[g]enerating the long preamble sequence section of the preamble." EX1007, 21, 62. IEEE further discloses an example of a generated LTS, as reproduced above at page 48. *Id.*, 21; EX1003, ¶121.

To the extent that IEEE does not expressly use the term a "signal generator," a POSITA would have recognized that IEEE's transmitter predictably included a signal generator that generates IEEE's long OFDM training symbol. EX1003, ¶122. Additionally, Zelst suggests generating an "extended long training sequence," as shown in Figure 15A, and for the reasons articulated below, a POSITA would have been prompted to implement IEEE's transmitter according to Zelst's suggested LTSs for extended devices (including Zelst's ELTS of Figure

15A). EX1006, [0027]; *see id.*, [0012], [0016], [0082], FIG. 4, FIG. 15A. While the outermost boundaries of the term “extended long training sequence” are subject to alternative interpretations (Section VI), there is no dispute the element plainly encompasses at least the preferred embodiment of the ’842 patent shown in

5 Figure 5. EX1001, 5:20-25; EX1003, ¶123. Zelst teaches the same ELTS as is disclosed as the preferred embodiment in the ’842 patent. EX1006, FIG. 15A; *supra*, pp. 50-52.

The evidence here shows multiple reasons existed that would have prompted a POSITA to implement the OFDM transmitter of IEEE to generate Zelst’s ELTS shown in Figure 15A (resulting in an ELTS with a PAPR). **First**, such a predictable implementation of IEEE would have advantageously resulted in a transmitter that generates ELTSs. EX1003, ¶124. Zelst suggests the importance of coexistence and interoperability between devices that use different communication standards. EX1006, [0004]-[0005]. Thus, a POSITA would have been motivated to modify the transmitter of IEEE to permit the generating of ELTSs to beneficially promote coexistence and interoperability. EX1003, ¶124. **Second**, the predictable implementation of IEEE would have advantageously resulted in the use of ELTSs. *Id.* Zelst stated that an ELTS allows “energy [to be] transmitted on every single tone except the DC tone,” thus increasing the efficiency in data transfer. EX1006, [0106]; EX1003, ¶124. Thus, a POSITA would have been motivated to modify the

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transmitter of IEEE to allow generating of ELTSs so that more data can be transferred using those sequences. EX1003, ¶124. **Third**, doing so would have been merely the application of a known technique (*e.g.*, generating an ELTS with a minimal PAPR) to a known system (IEEE's transmitter) ready for improvement to yield predictable results. *KSR*, 550 U.S. at 417. Indeed, the '842 patent admitted that generating the same ELTS as Zelst's sequence would result in a sequence with "the minimum peak-to-average power ratio, i.e., a peak-to-average power ratio of 3.6 dB." Compare EX1001, FIG. 5, 5:20-25, with EX1006, FIG. 15A. A POSITA would have recognized that applying Zelst's suggestion of generating the sequence in its Figure 15A to IEEE's transmitter would have led to predictable results without significantly altering or hindering the functions performed by IEEE's transmitter. EX1003, ¶124. Thus, it would have been obvious to a POSITA to modify the OFDM transmitter of IEEE in light of Zelst's teaching of generating ELTSs, which would result in a signal generator that generates ELTSs. EX1003, ¶124.

[1.b] an Inverse Fourier Transformer operatively coupled to the signal generator,

IEEE discloses this element. EX1003, ¶¶126-128. IEEE discloses a transmitter that includes an "IFFT," and that the generated frequency domain LTS

is input into an IFFT, which outputs a time domain LTS. EX1007, 16, 32, 62, 67, FIG. 118.

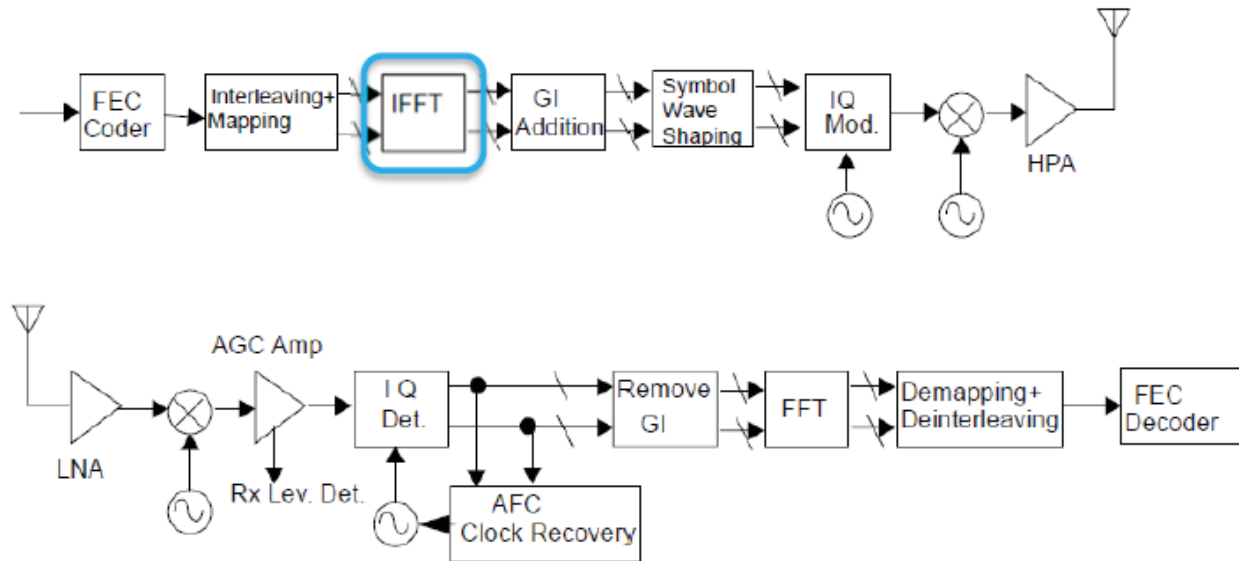


Figure 118—Transmitter and receiver block diagram for the OFDM PHY

EX1007 at FIG. 118 (annotated).

5 To the extent that IEEE does not explicitly teach that its “IFFT” transforms an input signal from the frequency to the time domain, the evidence here confirms a POSITA would have understood this to be the function of IEEE’s IFFT block. EX1003, ¶128. A POSITA would have further understood that performing an IFFT operation requires a circuit and/or software coupled to the signal generator.

10 *Id.*

[1.c] wherein the Inverse Fourier Transformer processes the extended long training sequence from the signal generator and provides an optimal

***extended long training sequence with a minimal peak-to-average ratio,
and***

The predictable combination of IEEE and Zelst discloses this element.

EX1003, ¶¶129-136. As discussed in Section IX.C (element [1.b]), IEEE discloses
5 an Inverse Fourier Transformer that processes the ELTS. EX1007, 16, 32, 62, 67,
FIG. 118. To the extent that IEEE does not explicitly teach processing the ELTS
from the signal generator and provides an optimal ELTS with a minimal PAPR,
Zelst teaches the ELTS shown in Figure 15A (depicted above, *supra*, pp. 50-52).
Ex. 1006 at FIG. 15A.

10 While the outermost boundaries of the claim term “optimal extended long
training sequence” are subject to alternative interpretations (Section VI), there is
no dispute this element plainly encompasses at least the preferred embodiment of
the ’842 patent: “FIG 5 illustrates the long training sequence with a minimum
peak-to-average power ratio[.]” EX1001, 5:20-21. Zelst teaches an ELTS that is
15 the same as ’842 patent’s “long training sequence with a minimum peak-to-average
power ratio” of Figure 4. EX1006, FIG. 15A; EX1003, ¶¶131-134; *supra*, pp. 50-
52. Thus, Zelst teaches the same input to the IFFT (ELTS of Figure 15A of Zelst)
as the ’842 patent (ELTS of Figure 4), so the IFFT outputs the same optimal ELTS
as in the preferred embodiment of the ’842 patent. EX1003, ¶¶134-135.

While Zelst does not explicitly teach that the sequence of its Figure 15A achieves the minimal peak-to-average ratio of “3.6 dB,” this characteristic of the sequence was inherent in Zelst for the same reasons discussed above in Section VII.B (element [1.c]) regarding the L2 sequence disclosed in Jones’ Figure 4. *See* EX1003, ¶¶53, 62, 133-134.

Notably, as shown above in Section IX.A, Zelst’s ELTS is **identical** to the ELTS that the ’842 patent teaches as having “**the minimum peak-to-average power ratio, i.e., a peak-to-average power ratio of 3.6 dB.**” EX1001, 5:20-25; *supra*, pp. 50-52. Even though Zelst did not explicitly recognize that the sequence of Figure 15A provides the optimal sequence with the minimum PAPR of “3.6 dB,” this result was necessarily present and inherent in Zelst’s suggested system. Moreover, the extrinsic evidence “makes clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill.” *Continental*, 948 F.2d at 1268; *see* EX1003, ¶¶53, 62, 133-134; EX1001, 5:2-25 (admitting that these characteristics resulted from the same sequence shown in Zelst’s Figure 15A).

The evidence here shows multiple reasons existed that would have prompted a POSITA to implement the transmitter of IEEE to generate Zelst’s ELTS shown in Figure 15A (resulting in an ELTS with a PAPR). **First**, such a predictable implementation of IEEE would have advantageously resulted in a transmitter that

provides a sequence with a minimal PAPR. EX1003, ¶135. Zelst recognizes a desire to select an ELTS with a low PAPR. See EX1006, [0106]. Thus, a POSITA would have been motivated to implement an ELTS, such as the one in Zelst's Figure 15A. EX1003, ¶135. **Second**, doing so would have been merely the application of a known technique (*e.g.*, generating an ELTS with a minimal PAPR) to a known system (IEEE's transmitter) ready for improvement to yield predictable results. *KSR*, 550 U.S. at 417. Indeed, the '842 patent admitted that generating the same ELTS as Zelst's sequence would have resulted in a sequence with "the minimum peak-to-average power ratio, i.e., a peak-to-average power ratio of 3.6 dB." Compare EX1001, FIG. 5, 5:20-25, with EX1006, FIG. 15A. A POSITA would have recognized that applying Zelst's suggestion of generating the sequence in its Figure 15A to IEEE's transmitter would have led to predictable results without significantly altering or hindering the functions performed by IEEE's transmitter. EX1003, ¶135.

[1.d] wherein at least the optimal extended long training sequence is carried by a greater number of subcarriers than a standard wireless networking configuration for an Orthogonal Frequency Division Multiplexing scheme.

The predictable combination of IEEE and Zelst discloses this element.

EX1003, ¶¶137-139. Zelst explains that in "a legacy 802.11a packet, one 3.2 microsecond repetition of the long training symbol L ... is expressed in the time

domain as the IFFT of $L(k)$, where $L(k)$ contains 64 subcarrier values, of which 52 are non-zero.” EX1006, [0081]. In contrast, Zelst teaches an extended mode LTS that “can ***contain more than 52 non-zero subcarriers.***” *Id.*, [0082]. Zelst further discloses a “long training sequence disposed in a preamble ... ***comprising more***
5 ***non-zero tones than the number of non-zero tones disposed in corresponding long training sequence defined by the 802.11 standard.***” *Id.*, 13 (claim 20). Zelst further teaches performing an IFFT on the ELTS shown in Figure 15A to generate an ELTS in the time domain. *Id.*, [0008]. A POSITA would have recognized that performing an IFFT on the sequence in Zelst’s Figure 15A with 63 active
10 subcarriers would yield an optimal ELTS (in the time domain) that is carried by 63 subcarriers. EX1003, ¶138.

While the outermost boundaries of the claim term “a standard wireless networking configuration for an Orthogonal Frequency Division Multiplexing scheme” are subject to alternative interpretations (Section VI), there is no dispute
15 this element plainly encompasses at least the preferred embodiment of the ’842 patent—where “only 52 of the 64 active subcarriers are used” in “802.11a and 802.11g compliant devices,” but the ’842 patent’s “optimal expanded long training sequence may be used in ... 63 [subcarriers]. EX1001, 2:14-16, 4:59-61; EX1003, ¶138. Zelst clearly teaches such an optimal ELTS with 63 subcarriers, which is
20 more than the 52 subcarriers in an 802.11a/g system for an OFDM scheme. As

discussed in Section IX.C (element [1.c]), a POSITA would have been motivated to implement the transmitter of IEEE to generate Zelst's ELTS shown in Figure 15A. EX1003, ¶135.

5 **[2] *The wireless communications device according to claim 1, wherein at least the optimal extended long training sequence is carried by at least 56 active sub-carriers.***

As discussed in Section IX.C (element [1.d]), the predictable combination of IEEE and Zelst discloses that at least the optimal ELTS is carried by 63 active subcarriers. EX1006, [0008], [0081]-[0082], 13 (claim 20); EX1001, 2:14-16, 4:5961; EX1003, ¶140.

10 **[3] *The wireless communications device according to claim 2, wherein the at least 56 active sub-carriers correspond to at least indexed sub-carriers -28 to +28.***

The predictable combination of IEEE and Zelst discloses that the at least 56 active sub-carriers correspond to at least indexed sub-carriers -28 to +28.

EX1003, ¶141. As discussed in Section IX.C (claim 2), Zelst teaches an ELTS in Figure 15A with 63 subcarriers that is input into an IFFT, which generates an output. EX1006, FIG. 15A, [0008], [0050], [0079]-[0082], 13 (claim 20), EX1003, ¶140. A POSITA would have recognized that using the ELTS of Zelst's

20 Figure 15A as an input would result in an output having 63 non-zero subcarriers

corresponding to indexed subcarriers -32 to -1 and 1 to +31,¹²—or at least indexed subcarriers -28 to +28. EX1003, ¶141.

[4] *The wireless communications device according to claim 2, wherein the optimal extended long training sequence has a minimum peak-to-average power ratio of 3.6 dB.*

As discussed in Section IX.C (element [1.c]), the predictable combination of IEEE and Zelst discloses this element. EX1007, 67; EX1006, [0106], FIG. 15A; EX1001, 5:20-25, FIG. 5; EX1003, ¶142.

[8] *The wireless communications device according to claim 1, wherein a binary phase shift key encoding is used for each sub-carrier above the +26 indexed sub-carrier and below the -26 indexed sub-carrier.*

The predictable combination of IEEE and Zelst discloses this element. EX1003, ¶¶143-144. IEEE discloses that the 802.11a standard allows BPSK encoding. EX1007, 11. Additionally, Zelst teaches an extended long sequence with 63 non-zero subcarriers.

$$\{ \begin{matrix} -1, & -1, & 1, & 1, & 1, & 1, & 1, & 1, & -1, & -1, & 1, & 1, & -1, & 1, & -1, & 1, \\ 1, & 1, & 1, & 1, & 1, & -1, & -1, & 1, & 1, & -1, & 1, & -1, & 1, & 1, & 1, & 1, \\ 0, & 1, & -1, & -1, & 1, & 1, & -1, & 1, & -1, & 1, & -1, & -1, & -1, & -1, & -1, & 1, \\ 1, & -1, & -1, & 1, & -1, & 1, & -1, & 1, & 1, & 1, & 1, & -1, & -1, & -1, & 1, & -1, \end{matrix} \}$$

EX1006, FIG. 15A (color added).

¹² A POSITA would further recognize that the optimal LTS would include a DC subcarrier at subcarrier index 0. EX1003, ¶141.

The yellow highlighting above shows each subcarrier above the +26 indexed subcarrier and below the -26 indexed subcarrier. Notably, each value is either -1 or 1, so BPSK encoding was used for each subcarrier. EX1003, ¶¶143-144. Thus, the combination of IEEE and Zelst discloses BPSK encoding is used for each subcarrier above the +26 indexed subcarrier and below the -26 indexed subcarrier.

[11] The wireless communications device according to claim 1, wherein the wireless communications device comprises a wireless mobile communications device.

The predictable combination of IEEE and Zelst discloses this element.

EX1003, ¶¶145-150. IEEE teaches the use of OFDM devices for wireless transmitting and receiving data. See EX1007, 12. Zelst discloses a “wireless network” for “communications among transmitters and receivers.” EX1006, [0035].

In light of the disclosures of IEEE and Zelst, a POSITA would have recognized that the disclosed OFDM devices could be mobile devices, as wireless devices are, by definition, devices without wires, which are therefore portable or mobile. EX1003, ¶¶148-149. Indeed, the devices of IEEE and Zelst are both devices that communicate wirelessly using OFDM systems, and a POSITA would have further recognized that devices that communicate in a wireless network can be mobile. *Id.* Thus, the obvious combination of IEEE and Zelst teaches a wireless mobile communication device.

[14] The wireless communications device according to claim 1, wherein the optimal extended long training sequence is longer than a long training sequence used by a legacy wireless local area network device in accordance with a legacy wireless networking protocol standard.

5 The predictable combination of IEEE and Zelst discloses this element.

EX1003, ¶¶151-154. IEEE discloses that the 802.11a legacy wireless networking protocol standard uses “52 subcarriers.” See EX1007, 11; EX1003, ¶153. The ELTS of Zelst’s Figure 15A has 63 active subcarriers. EX1006, FIG. 15A. A POSITA would have recognized that when an IFFT is performed on an ELTS
10 with 63 active subcarriers, an optimal ELTS with **63 active subcarriers** is produced. EX1003, ¶153.

While the outermost boundaries of the term “a legacy wireless local area network device in accordance with a legacy wireless networking protocol standard” are subject to alternative interpretations (Section VI), there is no dispute
15 this element plainly encompasses at least the preferred embodiment of the ’842 patent—that is, 802.11a or 802.11g compliant devices. EX1001, 4:6-8; EX1003, ¶¶152. As explained above, Zelst teaches wherein the optimal ELTS is carried by 63 subcarriers, which is longer than a 52-subcarrier LTS used by 802.11a or 802.11g compliant devices. EX1003, ¶153.

Thus, the combination of IEEE and Zelst discloses an ELTS with 63 active subcarriers, which is longer than an LTS used in legacy WLAN device (*e.g.*, 52 subcarriers).

5 **[19] The wireless communications device according to claim 1, wherein the extended long training sequence or the optimal extended long training sequence is encoded using binary phase shift key encoding on each of the subcarriers.**

As discussed in Section IX.C (claim 8), the combination of IEEE and Zelst discloses this element. EX1007, 11; EX1006, FIG. 15A; EX1003, ¶155.

10 Figure 15A of Zelst shows that BPSK encoding is used on every active subcarrier of the ELTS. EX1006, FIG. 15A, EX1003, ¶156. Additionally, IEEE states that the 802.11a standard allows for BPSK encoding. EX1007, 11.

While the outermost boundaries of the term “extended long training sequence” are subject to alternative interpretations (Section VI), there is no dispute
15 this element plainly encompasses at least the preferred embodiment of the ’842 patent shown in Figure 5. EX1001, 5:20-25; EX1003, ¶156. As the ’842 patent explains, “[t]he long training sequence of 802.11a and 802.11g is defined such that each of sub-carriers -26 to +26 has one BPSK constellation[sic] point, either +1 or 1.” EX1001, 2:29-35. As shown in Figure 15A of Zelst, BPSK encoding is
20 applied to each active subcarrier in the LTS (all non-zero subcarriers), which is identical to the preferred embodiment of the ’842 patent. EX1003, ¶156. Thus,

Zelst discloses that the ELTS or the optimal ELTS is encoded using BPSK encoding on each of the subcarriers.

X. GROUND 4: CLAIMS 1, 2, 3, 4, 8, 11, 14, AND 19 ARE OBVIOUS OVER IEEE IN VIEW OF ZELST AND KHANDANI

As discussed in Section IX.A, IEEE discloses an OFDM transmitter including using FEC encoder, interleaving and mapping, and IFFT blocks.

EX1007, FIG. 118. As discussed in Section IX.B, Zelst discloses a “modified preamble” for use by “extended devices.” EX1006, Abstract. Zelst teaches a 64-tone ELTS that is identical to the LTS that the ’842 patent shows in Figure 5 and teaches as having “a minimum peak-to-average power ratio that is used in 63 active subcarriers.” *Compare* EX1006, FIG. 15A, with EX1001, FIG. 5, 5:20-25.

While Zelst teaches the same LTS used in 63 active subcarriers as taught by the ’842 patent as achieving the minimum PAPR, it does not explicitly teach that its sequence provides the “optimal extended long training sequence with a minimal peak-to-average ratio” (element [1.c]) or specifically that the minimal PAPR is 3.6 dB (claims 4 and 7). To the extent that these characteristics of Zelst’s sequence are not inherent (which they are), the predictable combination of IEEE in view of Zelst and Khandani would provide these features. Like IEEE and Zelst, Khandani is directed to a multi-carrier (*e.g.*, OFDM) system. EX1005, [0075]. For the reasons articulated below, a POSITA would have been motivated to combine the

transmitter of IEEE with the ELTS of Zelst with Khandani's suggestion for minimizing PAPR in order to provide a device that generates optimal ELTS for wireless communication. EX1003, ¶159.

[1.P] A wireless communications device, comprising:

5 As discussed in Section IX.C (element [1.P]), IEEE discloses this element. EX1007, 11, 32, FIG. 118; EX1003, ¶161.

[1.a] a signal generator that generates an extended long training sequence; and

As discussed in Section IX.C (element [1.a]), the combination of IEEE and Zelst discloses this element. EX1007, 21, 32, 62, FIG. 118; EX1006,
10 [0004]-[0005], [0027], [0012], [0016], [0082], [0106], FIG. 4, FIG. 15A; EX1001, 5:20-25, FIG. 5; EX1003, ¶¶162-165.

[1.b] an Inverse Fourier Transformer operatively coupled to the signal generator,

As discussed in Section IX.C (element [1.b]), IEEE discloses this element.
15 EX1007, 16, 32, 62, 67, FIG. 118; EX1003, ¶¶166-167.

[1.c] wherein the Inverse Fourier Transformer processes the extended long training sequence from the signal generator and provides an optimal extended long training sequence with a minimal peak-to-average ratio, and

20 As discussed in Section IX.C (element [1.c]), the combination of IEEE and Zelst discloses this element. EX1006, [0106], FIG. 15A; EX1001, 5:20-25, FIG. 5; EX1003, ¶¶168-172. As explained in Section IV.C (element [1.c]), Zelst teaches

the same ELTS in its Figure 15A that the '842 patent admits to resulting in “the minimum peak-to-average power ratio, i.e., a peak-to-average power ratio of 3.6 dB.” EX1006, FIG. 15A; EX1001, FIG. 5, 5:20-25; *supra*, pp. 50-52. To the extent that Zelst itself does not teach these specific characteristics of its ELTS,

5 Khandani suggests selecting an LTS that would achieve a minimal PAPR.

EX1005, [0082]. As shown in Figure 3, Khandani teaches “evaluating the peak average power ratio for all the various permutations” and “searching through all possible permutations of choices” to select the selecting the permutation that “will result in the smallest possible peak average power ratio.” EX1005, [0082], FIG. 3.

10 The evidence here shows multiple reasons existed that would have prompted a POSITA to implement the transmitter of IEEE with the ELTS of Zelst (Figure 15A) based on Khandani’s express suggestion (for selecting the permutation that results in the smallest possible PAPR). **First**, such a predictable implementation of IEEE would have advantageously provided a transmitter that generates an ELTS
15 with the minimal possible PAPR among the possible permutations. EX1003, ¶¶159, 172. As previously detailed, the sequence of Zelst’s Figure 15A includes more than 52 non-zero subcarriers—specifically, 11 additional subcarriers. See EX1006, FIG. 4, FIG. 15A. Khandani provides an explicit suggestion that an ELTS that results in a minimal PAPR should be selected. EX1005, [0082]. Thus,
20 a POSITA would have been motivated to evaluate the various permutations to

select the sequence shown in Zelst's Figure 15A and apply the teachings of Khandani to determine that the sequence achieved the smallest possible PAPR (*e.g.*, 3.6 dB). EX1003, ¶¶171-172. **Second**, doing so would have been merely the application of a known technique (*e.g.*, selecting the permutation that results in the smallest possible PAPAR) to a known system (IEEE's transmitter) ready for improvement to yield predictable results. *KSR*, 550 U.S. at 417. Indeed, the '842 patent admitted that employing the same ELTS as Zelst's sequence would have resulted in "the minimum peak-to-average power ratio, i.e., a peak-to-average power ratio of 3.6 dB." Compare EX1001, FIG. 5, 5:20-25, with EX1004, FIG. 4 (L2). A POSITA would have recognized that applying Khandani's suggestion to IEEE's transmitter and Zelst's sequence would have led to predictable results without significantly altering or hindering the functions performed by IEEE's transmitter. EX1003, ¶172.

[1.d] wherein at least the optimal extended long training sequence is carried by a greater number of subcarriers than a standard wireless networking configuration for an Orthogonal Frequency Division Multiplexing scheme.

As discussed in Section IX.B (element [1.d]), the combination of IEEE and Zelst teaches this element. EX1007, 11; EX1006, [0008], [0081]-[0082], 13 (claim 20); EX1001, 2:14-16, 4:59-61; EX1003, ¶173.

[2] ***The wireless communications device according to claim 1, wherein at least the optimal extended long training sequence is carried by at least 56 active sub-carriers.***

As discussed in Section IX.B (claim 2), the combination of IEEE, Zelst, and

5 Khandani teaches this element. EX1007, 11; EX1006, [0008], [0081]-[0082], 13 (claim 20); EX1001, 2:14-16, 4:59-61; EX1003, ¶174.

[3] ***The wireless communications device according to claim 2, wherein the at least 56 active sub-carriers correspond to at least indexed sub-carriers -28 to +28.***

10 As discussed in Section IX.B (claim 3), the combination of IEEE and Zelst teaches this element. EX1006, FIG. 15A, [0008], [0050], [0079]-[0082], 13 (claim 20), EX1003, ¶175.

[4] ***The wireless communications device according to claim 2, wherein the optimal extended long training sequence has a minimum peak-to-average power ratio of 3.6 dB.***

15 As discussed in Section IX (element [1.c]), the combination of IEEE and Zelst teaches this element. EX1007, 16, 32, 62, 67, FIG. 118; EX1006, [0106], FIG. 4, FIG. 15A; EX1001, 5:20-25, FIG. 5; EX1005, [0082]; EX1003, ¶176.

[8] ***The wireless communications device according to claim 1, wherein a binary phase shift key encoding is used for each sub-carrier above the +26 indexed sub-carrier and below the -26 indexed sub-carrier.***

20 As discussed in Section IX.B (claim 8), the combination of IEEE and Zelst teaches this element. EX1007, 11, 27; EX1006, FIG. 15A; EX1003, ¶177.

[11] The wireless communications device according to claim 1, wherein the wireless communications device comprises a wireless mobile communications device.

As discussed in Section IX.B (claim 11), the combination of IEEE and Zelst

5 teaches this element. EX1007, 12; EX1006, [0034]-[0035]; EX1003, ¶178.

[14] The wireless communications device according to claim 1, wherein the optimal extended long training sequence is longer than a long training sequence used by a legacy wireless local area network device in accordance with a legacy wireless networking protocol standard.

10 As discussed in Section IX.B (claim 14), the combination of IEEE and Zelst

teaches this element. EX1007, 11; EX1006, FIG. 15A; EX1001, 4:6-8; EX1003,

¶179.

[19] The wireless communications device according to claim 1, wherein the extended long training sequence or the optimal extended long training sequence is encoded using binary phase shift key encoding on each of the subcarriers.

15

As discussed in Section IX.B (claim 19), the combination of IEEE and Zelst

teaches this element. EX1007, 11; EX1006, FIG. 15A; EX1001, 2:29-35, 5:20-25,

FIG. 5; EX1003, ¶180.

20 **XI. CONCLUSION**

Based on the evidence set forth in Grounds 1-4 above, Petitioners request *inter partes* review of all the Challenged Claims.

(Case No. IPR2019-01345)

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Respectfully Submitted,

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CERTIFICATION UNDER 37 C.F.R. §42.24(d)

Under the provisions of 37 C.F.R. §42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter Partes* Review totals 12,637 words, which is less than the 14,000 allowed under 37 C.F.R. §42.24(a)(i).

Dated: July 18, 2019

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on July 18, 2019, a complete and entire copy of this Petition for *Inter Partes* Review and all supporting exhibits were provided by Federal Express, cost prepaid, to the Patent Owner by serving the correspondence address of record as follows:

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