

UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD

NXP USA, INC.,
Petitioner,

v.

BELL NORTHERN RESEARCH, LLC,
Patent Owner

Case: IPR2024-01044
U.S. Patent No. RE48,629

PATENT OWNER'S PRELIMINARY RESPONSE

Under 37 C.F.R. § 42.107

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Exhibit	Description
2001	Declaration of Dr. Todor Cooklev

I. INTRODUCTION

Petitioner NXP USA, Inc. (“Petitioner”) filed a Petition for Inter Partes Review of claims 1, 4, 8-23 and 27 of U.S. Patent No. RE48,629 (“the ‘629 patent”) on June 21, 2024. The Petition should be denied for the following reasons.

With respect to Ground 1, first, none of the references proposed in the Petition either “process” or “provide” an extended long-training sequence, as required by element 1[c] of the ‘629 patent. Petitioner’s argument that Zelst provides a “56 subcarrier ELTS” is self-refuting as it argues that the extended long training sequence is provided by both the IFFT and the signal generator. Second, the combination of references in the Petition fails to show that a person of ordinary skill in the art would be led to use exactly 56 subcarriers to achieve the goals of the ‘629 patent as required by element 1[e], let alone that the exact 56 subcarriers claimed by the patent would be used, as required by element 1[f]. Indeed, Petitioner’s proposed combinations actually teach away from both the use of 56 subcarriers and the ‘629 patent’s specific claimed 56 subcarrier sequence.

With respect to Ground 2, the only change from Ground 1 is the deletion of the Zelst reference from Petitioner’s proposed combination. But Petitioner relies on the Zelst reference for its disclosure of element 1[c] of the ‘629 patent in Ground 1, and provides no evidence that any other reference discloses this

limitation. And again, Petitioner's proposed combination actually teaches away from the claimed invention.

For at least these reasons, and those set forth below, the Petition should be denied and the claims upheld.

II. APPLICABLE LEGAL PRINCIPLES

"[T]he decision whether to institute an *inter partes* review is discretionary." *Unified Patents Inc. v. C-Cation Techs., LLC*, IPR2015-01045, Paper 15 at 3 (PTAB Oct. 7, 2015) (citing 37 C.F.R. § 42.108(a)). Petitioner has the burden to show that it is likely to prevail as to at least one claim of the '629 patent. 35 U.S.C. § 314; *SAS Institute Inc. v. Iancu*, 138 S. Ct. 1348 (2018).

To make a *prima facie* showing of obviousness under 35 U.S.C. § 103, the Petition must fulfill the requirements set forth in *Graham v. John Deere Co.*, 383 U.S. 1 (1966), including demonstrating that the cited references disclose each element of a challenged claim. *In re Magnum Oil Tools Int'l.*, 829 F.3d 1364, 1376 (Fed. Cir. 2016); *see also Apple Inc. v. Contentguard Holdings, Inc.*, IPR2015-00442, Paper 9 at 12-13 (PTAB July 13, 2015).

Petitioner also has the burden to show there would have been some motivation to modify or combine the asserted prior art, and that the proposed modifications or combinations would render the patented claims obvious. *Johns Manville v. Knauf Insulation*, IPR2018-00827, Paper 9 at 13 (PTAB Oct. 16, 2018) (informative). "Obviousness requires more than a mere showing that the prior art

includes separate references covering each separate limitation in a claim under examination.” *Unigene Labs., Inc. v. Apotex, Inc.*, 655 F.3d 1352, 1360 (Fed. Cir. 2011) (internal citation omitted); *see also In re Magnum Oil Tools Int’l.*, 829 F.3d at 1376. It does not suffice that an element is simply known in a prior art reference; “a reason for combining must exist.” *Virtek Vision Int’l ULC v. Assembly Guidance Sys., Inc.*, 97 F.4th 882 (Fed. Cir. 2024).

It is insufficient that “a skilled artisan, once presented with the two references, would have understood that they could be combined,” because “it does not imply a motivation to pick out those two references and combine them to arrive at the claimed invention.” *PersonalWeb Techs., LLC v. Apple, Inc.*, 848 F.3d 987, 993-94 (Fed. Cir. 2017) (internal citations omitted). Nor is it enough to show that the references are in the same field of invention or are compatible. *Johns Manville v. Knauf Insulation*, IPR2018-00827, Paper 9 at 17-20 (PTAB Oct. 16, 2018) (informative). There must be some reason for a POSITA to have been motivated to modify the prior art.

Even if individual modifications or choices were obvious, a petition must explain why making all of the changes at once would be obvious. *Apple Inc. v. Contentguard*, Paper 9 at 16-17 (“[T]he mere fact that individual changes might have been obvious does not make doing all of the changes at once obvious.”); *Innogenetics*, 512 F.3d at 1373 (Fed. Cir. 2008) (“[K]nowledge of a problem and motivation to solve it are entirely different from motivation to combine particular

references"); *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir.

2015) (“[O]bviousness concerns whether a skilled artisan not only *could have made* but *would have been motivated to make* the combinations or modifications of prior art to arrive at the claimed invention.”). The lack of a technological obstacle to combining references, in and of itself, does not justify a finding of obviousness. *See In re Omeprazole Patent Litig. v. Apotex Corp.*, 536 F.3d 1361, 1380-81 (Fed. Cir. 2008).

A reason for combining disparate prior art references or modifying prior art references is critical and should be made explicit. *InTouch Techs., Inc. v. VGo Communs., Inc.*, 751 F.3d 1327, 1351 (Fed. Cir. 2014) (internal citation omitted).

A conclusory statement relying on a duplicative expert testimony does not meet a petitioner's burden. *Johns Manville v. Knauf Insulation*, IPR2018-00827, Paper 9 at 13-14 (PTAB Oct. 16, 2018) (“Petitioner merely makes the assertion that it would have been so, and cites to a largely duplicative paragraph.... An unsupported statement that combining the teachings of the two references would have been ‘well within the skill of a POSA,’ because the results of reacting a reducing sugar with an amine reactant ‘were well-known and predictable’ does not meet Petitioner's burden.”) (informative); *see also id.* at 11; 37 C.F.R. § 42.65(a) (“Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.”).

Motivation and expectation of success are generally not present where the

proposed modification or combination contradicts a reference's basic teachings or is inoperable. *In re Urbanski*, 809 F.3d 1237, 1244 (Fed. Cir. 2016) ("A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.") (internal quotations omitted); *Cook Grp. Inc. v. Bos. Sci. Scimed, Inc.*, 809 F. App'x 990, 1001 (Fed. Cir. 2020) ("the Board properly weighed the loss of key functions as a relevant factor in the motivation to combine analysis"); *Plas-Pak Indus. v. Sulzer Mixpac AG*, 600 F. App'x 755, 758 (Fed. Cir. 2015); *In re Gordon*, 733 F.2d 900, 902 (Fed. Cir. 1984); *Univ. of Md. Biotechnology Inst. v. Presens Precision Sensing GmbH*, 711 F. App'x 1007, 1010 (Fed. Cir. 2017).

Hindsight analysis is inappropriate. Obviousness must be measured "*at the time the invention was made.*" *Ortho-McNeil Pharm. v. Mylan Labs*, 520 F.3d 1358, 1364 (Fed. Cir. 2008) (emphasis in original). A petition must demonstrate a rationale to modify or combine prior art references without relying on the patent disclosure itself. *Apple Inc. v. Contentguard*, Paper 9 at 15, 17; *see also P&G v. Teva Pharms. USA, Inc.*, 566 F.3d 989, 995 (Fed. Cir. 2009); *ActiveVideo Networks, Inc. v. Verizon Commc'ns, Inc.*, 694 F.3d 1312, 1327 (Fed. Cir. 2012) ("T]he expert's testimony on obviousness was essentially a conclusory statement that a person of ordinary skill in the art would have known, based on the 'modular' nature of the claimed components, how to combine any of a number of references

to achieve the claimed inventions. This is not sufficient and is fraught with hindsight bias.”). In other words, the Petitioner must not use the patent as a roadmap. *In re NTP, Inc.*, 654 F.3d 1279, 1299 (Fed. Cir. 2011) (internal citation omitted); *see also KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007).

III. BACKGROUND

A. Background of the Technology

Devices on a Wi-Fi network communicate with an access point (“AP”), which typically provides access to the Internet. Areas where Wi-Fi is available are often referred to as “hot spots”. Wi-Fi operates over frequency bands available to anyone at no cost (unlicensed frequencies). As a result, Wi-Fi is typically used without monthly fees (other than fees paid to the Internet Service Provider). Consumers desire high-speed data connectivity anytime, anywhere and generally prefer the high rates and lower cost offered by Wi-Fi. (EX2001, ¶ 72.)

In the 1990s, the IEEE developed a family of standards for use on wireless local area networks (“WLAN”) known as IEEE 802.11. Networks supporting IEEE 802.11 communications are often referred to as “Wi-Fi,” named after the Wi-Fi Alliance that certifies devices for compliance with IEEE 802.11. In the past two decades, the IEEE 802.11 wireless local area networks have experienced tremendous growth. WLAN devices are increasingly required to support various applications such as voice, video, cloud access, and traffic offloading. (EX2001, ¶¶ 73-74.)

It is almost always desirable to increase the data rate and every new standard (which can be called alternatively a standard amendment) provides a data rate that is higher than the previous standard. There are two main ways to increase the data rate – either by using more bandwidth or by increasing the spectrum efficiency. (EX2001, ¶ 75.)

Increasing the spectrum efficiency is typically more difficult than using more bandwidth. The spectrum efficiency of an OFDM system like IEEE 802.11 depends on the number of used subcarriers per OFDM symbol, the duration of the Guard Interval (also referred to as Cyclic Prefix), and the number of bits per subcarrier. (EX2001, ¶ 76.)

In the 802.11 wireless standards, including in legacy 802.11a/802.11g, each data packet transmitted from an access point to a terminal device includes a short training sequence followed by a long training sequence. These training sequences do not contain payload or user data, and are instead used for synchronization between the sender and the receiver. (EX1001 at 2:38-42; EX2001, ¶ 77.)

The '629 patent facilitates using more subcarriers per OFDM symbol and therefore contributes to increasing the spectrum efficiency. A conventional scheme like 802.11a uses 52 subcarriers out of the 64 available. (EX1001 at 2:24-26.) The conventional LTS is carried by 52 subcarriers. (*Id.*) The '629 patent not only recognizes that using more subcarriers is advantageous but describes and

claims a long training sequence that uses more subcarriers compared to the conventional approach. (EX1001 at 4:15-29; EX2001, ¶ 78.)

B. The '842 Patent

The '629 patent is a reissue of U.S. Patent No. 7,990,842 ("the '842 patent"). (EX1001, Cover.) The '842 patent claims priority to U.S. Application No. 60/591,104, filed Jul. 27, 2004; and U.S. Application No. 60/634,102, filed Dec. 8, 2004. (EX1003, Cover.)

The independent claim of the '842 patent recites:

1. A wireless communications device, comprising:

a signal generator that generates an extended long training sequence; and

an Inverse Fourier Transformer operatively coupled to the signal generator,

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

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.

C. Overview of the '629 Patent

As a reissue of the '842 patent, the '629 patent claims priority to its earliest effective filing date, which is July 27, 2004, the filing date of provisional application number 60/591,104. (EX1001, Cover.) Neither Dr. Buehrer nor

Petitioner has challenged this claimed priority date or otherwise contended that the claims are not entitled to this date.

The '629 patent resulted from the pioneering efforts of Messrs. Trachewsky and Moorti in the general area of wireless communication systems and more particularly to long training sequences of minimum peak-to-average power ratio which are appropriate for WLAN systems. (EX2001, ¶ 82.)

Two wireless devices (a station and an access point, for example) communicate with each other by modulating the data to be transmitted onto a multiplicity of discrete-frequency subcarriers (variously referred to as “subchannels,” “carriers,” “tones,” or “bins”). The discrete-frequency subcarriers are appropriately summed together to form a composite broadband signal that is then upconverted to a carrier frequency and transmitted. (EX2001, ¶ 83.)

The '629 patent explains that the then-prevalent IEEE 802.11a and g wireless standard compliant devices utilized only 52 of 64 active Orthogonal Frequency Division Multiplexing (OFDM) sub-carriers, namely, sub-carriers -26 to +26, with the 0-index sub-carrier set to 0. As such, only part of the 20 MHz bandwidth supported by 802.11a and 802.11g is used. (EX1001 at 2:24-37.) The introduction of the 802.11n standard allowed the use of more sub-carriers and more efficient use of bandwidth, resulting in higher throughput. (EX1001 at 1:67-2:2.) However, maintaining backwards compatibility with legacy (i.e., then-existing 802.11a and g devices) was a primary concern for the inventors of the '629 patent,

so that the use of more sub-carriers would not interfere with adjacent channels.

(EX1001 at 2:4-17; 2:46-48.) Accordingly, the inventors created an “optimal” extended long training sequence that could increase throughput by utilizing a greater number of sub-carriers than a long training sequence used in a legacy standard, with a minimal deviation from the peak-to-average power ratio (PAPR) of the long training sequence used by those standards.

OFDM is a frequency division multiplexing modulation technique for transmitting large amounts of digital data over a radio wave. OFDM works by spreading a single data stream over a band of sub-carriers, each of which is transmitted in parallel. (EX1001 at 2:22-24; EX2001, ¶ 84.)

Each subcarrier has a phase characteristic and an amplitude characteristic that corresponds to the value(s) of the one or more digital bits modulated on to the subcarrier. Using changes in the phase and amplitude to represent bits is referred to as Quadrature Amplitude Modulation (“QAM”). The subcarriers are referred to as QAM symbols. These QAM symbols are the input to the Inverse Fast Fourier Transform (IFFT). Modulating a multiplicity of subcarriers in this way is referred to as multicarrier modulation or Orthogonal Frequency-Division Multiplexing (ODFM). (EX2001, ¶ 84.)

The input to the IFFT is in the frequency-domain and output is in the time domain. The carriers are said to be in the frequency domain. The time-domain signal is a representation of the subcarriers. (EX2001, ¶ 85.)

At the receiver, the carriers of the received broadband signal are demodulated using a Fast Fourier Transform (FFT) to obtain again frequency-domain symbols from which the receiver estimates the transmitted symbols. The number of subcarriers, often denoted by the number N , should be sufficiently large so that each subchannel is characterized by fading that is approximately flat. Another practical consideration in the choice of N is the requirement to use an efficient algorithm for the calculation of the Discrete Fourier Transform (DFT). N is typically chosen to be a power of 2, because efficient FFT algorithms are readily available when N is a power of 2. (EX2001, ¶¶ 86-87.)

The number of subcarriers affect the data rate of the system. As an example, if 48 subcarriers are used for communicating data (out of 64 subcarriers total), and each subcarrier carries 6 bits encoded by a rate $3/4$ error-correcting code, each OFDM symbol would carry $48 \times 6 \times 3/4 = 216$ information bits. When 250,000 OFDM symbols are sent per second this would provide a bit rate of $216 \times 250,000 = 54,000,000$ bits per second or 54 Megabits per second. (EX2001, ¶ 88.)

At the time of the Inventors' pioneering efforts, conventionally implemented technology did not sufficiently address the problem of different wireless devices compliant with different standards or different versions of the same standard while enabling backward compatibility with legacy devices that avoids collisions. For example, in the 802.11a and 802.11g standards, each data packet starts with a preamble which includes a short training sequence followed by a long training

sequence. The short and long training sequences are used for synchronization between the sender and the receiver. The long training sequence of 802.11a and 802.11g is defined such that each of sub-carriers -26 to +26, except for the subcarrier 0 which is set to 0, has one binary phase shift keying constellation point, either +1 or -1. (EX2001, ¶ 89.)

The challenged claims of the '629 patent recite a wireless communications device, comprising: a signal generator that generates an extended long training sequence; and an Inverse Fourier Transformer operatively coupled to the signal generator, 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 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, wherein the optimal extended long training sequence is carried by exactly 56 active sub-carriers, and wherein the optimal extended long training sequence is represented by encodings for indexed sub-carriers -28 to +28, excluding indexed sub-carrier 0 which is set to zero, as follows:

<i>Sub-carrier</i>	-28	-27	-26	-25	-24	-23	-22
<i>Encoding</i>	+1	+1	+1	+1	-1	-1	+1
<i>Sub-carrier</i>	-14	-13	-12	-11	-10	-9	-8
<i>Encoding</i>	+1	+1	+1	-1	-1	+1	+1
<i>Sub-carrier</i>	1	2	3	4	5	6	7
<i>Encoding</i>	+1	-1	-1	+1	+1	-1	+1
<i>Sub-carrier</i>	15	16	17	18	19	20	21
<i>Encoding</i>	+1	+1	-1	-1	+1	-1	+1
<i>Sub-carrier</i>	-21	-20	-19	-18	-17	-16	-15
<i>Encoding</i>	+1	-1	+1	-1	+1	+1	+1
<i>Sub-carrier</i>	-7	-6	-5	-4	-3	-2	-1
<i>Encoding</i>	-1	+1	-1	+1	+1	+1	+1
<i>Sub-carrier</i>	8	9	10	11	12	13	14
<i>Encoding</i>	-1	+1	-1	-1	-1	-1	-1
<i>Sub-carrier</i>	22	23	24	25	26	27	28
<i>Encoding</i>	-1	+1	+1	+1	+1	-1	-1

One advantage of the patented invention is that it provides an expanded long-training sequence of minimum peak-to-average power ratio thereby decreasing power back-off. (EX1001 at 4:15-17.) Another advantage of the invention is that expanded long training sequences may be used by 802.11a and 802.11g devices for estimating the channel impulse response and by a receiver for estimating the carrier frequency offset between the transmitter clock and receiver clock. (EX1001 at 4:17-21.). (EX2001, ¶¶ 91-92.)

D. Challenged Claims

Petitioner has challenged claims 1, 4, 8-23, and 27 in its Petition. Claim 1, the only independent claim, recites;

1. A wireless communications device, comprising:
 - 1[a]: a signal generator that generates an extended long training sequence; and

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

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

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,

1[e]: wherein the optimal extended long training sequence is carried by exactly 56 active sub-carriers, and

1[f]: wherein the optimal extended long training sequence is represented by encodings for indexed sub-carriers -28 to $+28$, excluding indexed sub-carrier 0 which is set to zero, as follows:

<i>Sub-carrier</i>	-28	-27	-26	-25	-24	-23	-22
<i>Encoding</i>	$+1$	$+1$	$+1$	$+1$	-1	-1	$+1$
<i>Sub-carrier</i>	-14	-13	-12	-11	-10	-9	-8
<i>Encoding</i>	$+1$	$+1$	$+1$	-1	-1	$+1$	$+1$
<i>Sub-carrier</i>	1	2	3	4	5	6	7
<i>Encoding</i>	$+1$	-1	-1	$+1$	$+1$	-1	$+1$
<i>Sub-carrier</i>	15	16	17	18	19	20	21
<i>Encoding</i>	$+1$	$+1$	-1	-1	$+1$	-1	$+1$
<i>Sub-carrier</i>	-21	-20	-19	-18	-17	-16	-15
<i>Encoding</i>	$+1$	-1	$+1$	-1	$+1$	$+1$	$+1$
<i>Sub-carrier</i>	-7	-6	-5	-4	-3	-2	-1
<i>Encoding</i>	-1	$+1$	-1	$+1$	$+1$	$+1$	$+1$
<i>Sub-carrier</i>	8	9	10	11	12	13	14
<i>Encoding</i>	-1	$+1$	-1	-1	-1	-1	-1
<i>Sub-carrier</i>	22	23	24	25	26	27	28
<i>Encoding</i>	-1	$+1$	$+1$	$+1$	$+1$	-1	-1

(EX1001, Cl. 1.)

Claims 4, 8-23, and 27 depend from claim 1. (EX1001; Pet. at vi-ix.)

IV. CITED REFERENCES

A. 802.11-1999, 802.11a

The 802.11-1999 (EX1006) and 802.11a (EX1008) wireless standards are described in the '629 patent as “legacy” standards. The inventors of the '629 patent were concerned with maintaining backwards compatibility of upcoming wireless communications devices with the 802.11/802.11a standards. (*See* EX1001 at 2:4-17; 2:46-48.)

802.11-1999 and 802.11a used a long training sequence with 52 active subcarriers. This 52-subcarrier sequence is referred to as a “conventional” long training sequence in subsequent proposals (e.g., Jones):

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

(EX1008 at 21.)

B. Jones (EX1014)

U.S. Pat. No. 7,453,793 to Jones et al. (“Jones,” EX1014) is directed to providing improved techniques for use in MIMO-extended 802.11a and other wireless communication systems. (*Id.* at 3:29-31.) In relevant part, Jones (and the Jones Provisional) teach the use of a “conventional” 802.11a long training sequence L1 and “modified” long training sequences L2 and L3:

$$\begin{aligned}
 L1 &= \begin{Bmatrix} 0 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & -1 & 1 & -1 & -1 & -1 & -1 & -1 & 1 \\ 1 & -1 & -1 & 1 & -1 & 1 & -1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & -1 & 1 \\ 1 & 1 & 1 & 1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & -1 & 1 & 1 & 1 & 1 \end{Bmatrix} \\
 L2 &= \begin{Bmatrix} 0 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & -1 & 1 & -1 & -1 & -1 & -1 & -1 & 1 \\ 1 & -1 & -1 & 1 & -1 & 1 & -1 & 1 & 1 & 1 & 1 & -1 & -1 & -1 & 1 & -1 \\ -1 & -1 & 1 & 1 & 1 & 1 & 1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & -1 & 1 \\ 1 & 1 & 1 & 1 & 1 & -1 & -1 & 1 & 1 & -1 & 1 & -1 & 1 & 1 & 1 & 1 \end{Bmatrix} \\
 L3 &= \begin{Bmatrix} 0 & 1 & -1 & -1 & -1 & -1 & 1 & -1 & -1 & 1 & -1 & -1 & 1 & 1 & 1 & -1 \\ 1 & -1 & -1 & 1 & 1 & -1 & 1 & -1 & 1 & 1 & 1 & -1 & 1 & 1 & -1 & 1 \\ -1 & -1 & 1 & 1 & -1 & -1 & -1 & -1 & -1 & -1 & 1 & 1 & 1 & -1 & 1 & -1 \\ 1 & 1 & 1 & 1 & -1 & 1 & 1 & -1 & 1 & -1 & 1 & -1 & -1 & -1 & -1 & -1 \end{Bmatrix}
 \end{aligned}$$

(EX1030 at 23; EX1014 at Figs. 2, 4.)

The conventional long training sequence described by Jones uses 52 active subcarriers (L1). The “modified” long training sequences L2 and L3 use 63 active subcarriers.

C. Zelst (EX1010)

U.S. Pat. No. 7,599,332 to Zelst et al. (“Zelst” or the “Zelst non-provisional”) (EX1010) is directed to proposed “extensions” to the 802.11a standard; specifically, a “modified preamble” that is “provides some level of coexistence with legacy IEEE 802.11a devices.” (EX1010, Abstract.)

In relevant part, Zelst proposes two extended long training sequences relative to the 802.11a standard, for each of the 20 MHz and 40 MHz channels. The proposed extended long training sequence for a 20 MHz channel uses 63 active subcarriers and is shown in Fig. 15A of Zelst:

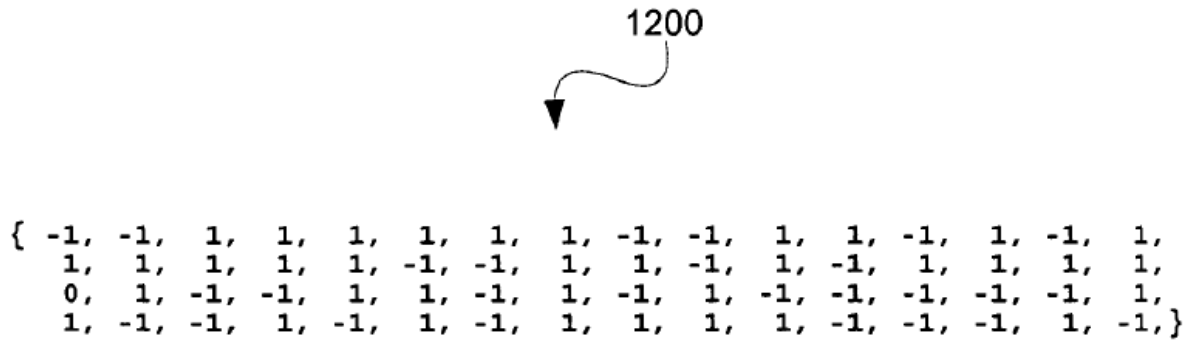


FIG. 15A

(EX1010 at Fig. 15A; 3:56-58.) The proposed extended long training sequence for a 40 MHz channel uses 127 active subcarriers and is shown in Fig. 16A:

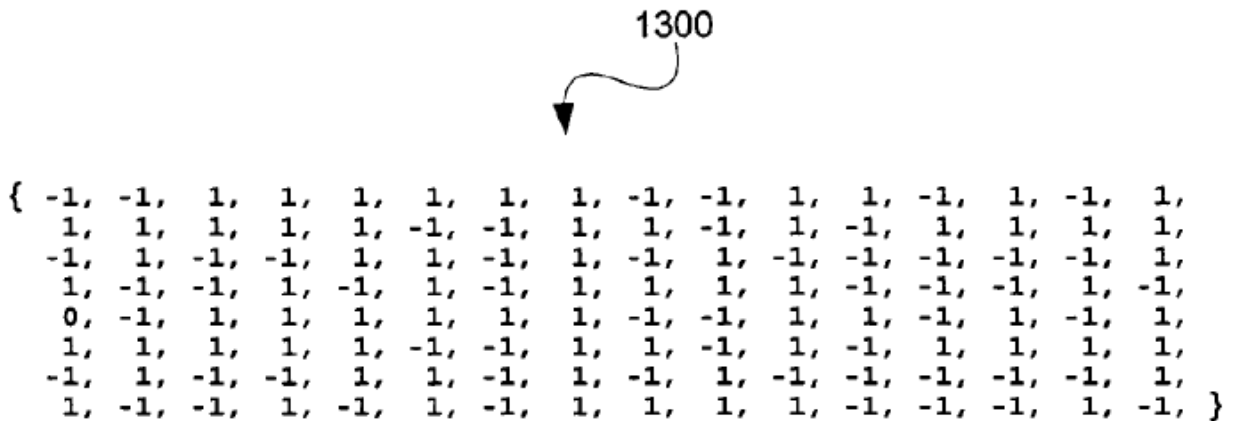


FIG. 16A

(EX1010 at Fig. 16A; 3:62-64.)

Zelst incorporates by reference U.S. provisional application No. 60/575,608, filed May 27, 2004. (EX1011, “Zelst Provisional”.) The Zelst Provisional teaches the same extended long training sequences as in Figs. 15A and 16A of Zelst:

20 MHz & 40 MHz Extended Long Training (ELT)

- **ELT for 20 MHz:**

$L_{-32,31} = \{-1, -1, 1, 1, 1, 1, 1, 1, -1, -1, 1, 1, -1, 1, -1, 1, 1, 1, 1, 1, -1, -1, 1, 1, -1, 1, -1, 1, 1, 1, 1, 0, 1, -1, -1, 1, 1, -1, 1, -1, 1, -1, -1, -1, -1, -1, 1, 1, -1, -1, 1, -1, 1, -1, 1, 1, 1, 1, -1, -1, -1, 1, -1\}$

- **ELT for 40 MHz:**

$L_{-64,63} = \{-1, -1, 1, 1, 1, 1, 1, 1, -1, -1, 1, 1, -1, 1, -1, 1, 1, 1, 1, 1, -1, -1, -1, 1, 1, -1, 1, -1, 1, -1, -1, -1, -1, 1, 1, -1, -1, 1, -1, 1, 1, 1, 1, -1, -1, -1, 1, -1, 0, -1, 1, 1, 1, 1, 1, 1, -1, -1, 1, 1, -1, 1, -1, 1, 1, 1, 1, 1, 1, 1, -1, -1, 1, 1, -1, -1, 1, 1, -1, -1, 1, 1, -1, -1, -1, -1, -1, 1, 1, -1, -1, 1, -1, 1, -1, 1, 1, 1, 1, -1, -1\}$

(EX1011 at 6.)

D. Boer (EX1012)

U.S. Pat. No. 8,014,267 to Boer et al. ("Boer," EX1012) is directed to:

A method and apparatus are disclosed for transmitting symbols in a multiple antenna wireless communication system, such that the symbols can be interpreted by a lower order receiver (i.e., a receiver having a fewer number of antennas than the transmitter). For example, subcarriers from one or more symbols can be transmitted such that each of the subcarriers are active on only one of the antennas at a given time.

(EX1012, Abstract.)

Boer explains that conventional training symbols increase the total overhead of the system by N_t , the number of transmitters in the system. (*Id.* at 2:1-6.)

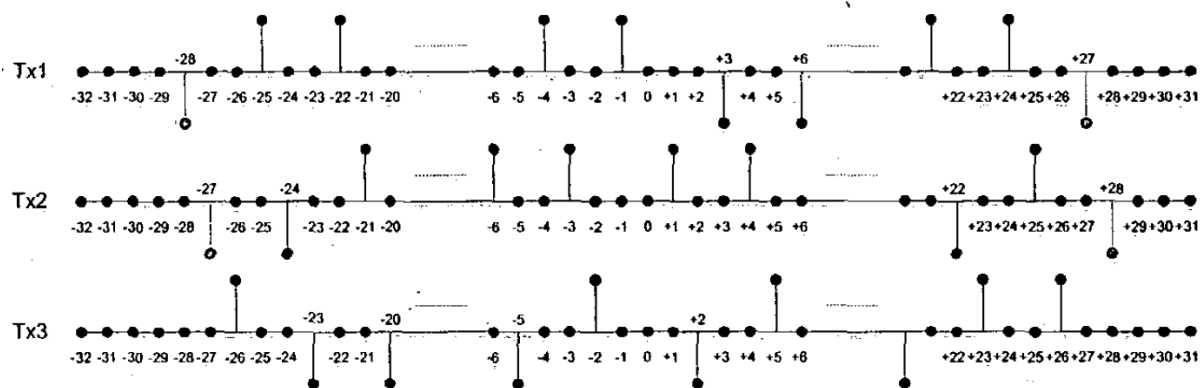
Accordingly, Boer teaches a “length-efficient training symbol” having a minimum length, preferably equal to the length of a training symbol in a conventional Single Input Single Output OFDM (SISO-OFDM) system. (*Id.* at 2:7-11.)

Boer incorporates by reference U.S. provisional application No. 60/483,719, filed Jun. 30, 2003 (the “Boer Provisional,” EX1013.) The Boer Provisional teaches that to achieve “the most efficient training of a MIMO-OFDM system”:

A MIMO-OFDM system with two transmit antennas needs 2 extra subcarriers, one at each side of the spectrum and *a MIMO-OFDM system with three transmit antennas needs 4 extra subcarriers, two at each side of the spectrum.*

...

Figure 2 gives a schematic representation of the MIMO-OFDM long training symbols *for a 3 transmit antenna system*, with additional subcarriers at the spectrum's edges. The extra subcarriers at the edges (red) are modulated in such a way that the peak-to-average power ratio (PAP) is lowest. Simulation results are given in the Appendix, Chapter 4.



(EX1013 at 5.)

The Boer Provisional further describes its use of the peak-to-average power (PAP) ratio of a long training sequence to select the most suitable subcarrier

encodings. Specifically, the Boer Provisional explains that a table in Appendix A should be used to determine the subcarrier encodings with the lowest PAP ratio.

(EX1013 at 29.) The Boer Provisional goes on to state: “*Preferably* the training sequence *with lowest PAP ratio* is used”:

5 PAP-ratio

An important feature of the 11a long training sequences is the low Peak-to-Average Power (PAP) ratio. This minimizes the effect of non-linearity of the PA and prevents clipping in the receiver's ADs. This section looks at the PAP ratios of the original 11a training sequence and the diagonally loaded training sequences for two or three transmit antennas and with zero, two or four additional subcarriers.

The PAP ratios for these training sequences are given in Appendix A. The training sequences with the lowest PAP ratios are listed in a red box. Preferably the training sequence with lowest PAP ratio is used.

(EX1013 at 29.)

Appendix A shows the PAP ratios for each of the 16 possible combinations of four additional subcarriers:

Appendix A: PAP ratios training sequences

	Xtra Bits	Antenna	Max Power	Mean Power	PAP
802.11a	0	1	4.1458	2.0000	2.0729
Diagonal-0	0000	1	4.0101	1.0000	4.0101
		2	3.8462	1.0000	3.8462
	0000	1	2.9518	1.0385	2.8424
		2	2.2940	0.9808	2.3390
		3	2.8269	0.9808	2.8824
Diagonal-2	0110	1	4.4815	1.0000	4.4815
		2	4.4815	1.0000	4.4815
	01-10	1	4.4815	1.0000	4.4815
		2	4.5817	1.0000	4.5817
	0-110	1	3.0000	1.0000	3.0000
		2	4.4815	1.0000	4.4815
	0-1-10	1	3.0000	1.0000	3.0000
		2	4.5817	1.0000	4.5817
Diagonal-4	1111	1	2.9337	1.0179	2.8822
		2	4.3393	1.0179	4.2632
		3	2.7409	0.9643	2.8424
	111-1	1	2.9337	1.0179	2.8822
		2	4.3393	1.0179	4.2632
		3	2.7409	0.9643	2.8424
	11-11	1	3.0600	1.0179	3.0063
		2	4.3393	1.0179	4.2632
		3	2.7409	0.9643	2.8424
	11-1-1	1	3.0600	1.0179	3.0063
		2	4.3393	1.0179	4.2632
		3	2.7409	0.9643	2.8424
	1-111	1	2.9337	1.0179	2.8822
		2	3.0265	1.0179	2.9734
		3	2.7409	0.9643	2.8424
	1-11-1	1	2.9337	1.0179	2.8822
		2	2.7592	1.0179	2.7108
		3	2.7409	0.9643	2.8424
	1-1-11	1	3.0600	1.0179	3.0063
		2	3.0265	1.0179	2.9734
		3	2.7409	0.9643	2.8424
	1-1-1-1	1	3.0600	1.0179	3.0063
		2	2.7592	1.0179	2.7108
		3	2.7409	0.9643	2.8424
	-1111	1	2.6520	1.0179	2.6055
		2	4.3393	1.0179	4.2632
		3	2.7409	0.9643	2.8424
	-111-1	1	2.6520	1.0179	2.6055
		2	4.3393	1.0179	4.2632

	-11-11	3	2.7409	0.9643	2.8424
		1	2.2224	1.0179	2.1834
		2	4.3393	1.0179	4.2632
		3	2.7409	0.9643	2.8424
	-11-1-1	1	2.2224	1.0179	2.1834
		2	4.3393	1.0179	4.2632
		3	2.7409	0.9643	2.8424
	-1-111	1	2.4626	1.0179	2.6055
		2	2.8103	1.0179	2.9734
		3	2.5451	0.9643	2.8424
	-1-11-1	1	2.6520	1.0179	2.6055
		2	2.7592	1.0179	2.7108
		3	2.5451	0.9643	2.8424
	-1-1-11	1	2.2224	1.0179	2.1834
		2	2.8103	1.0179	2.9734
		3	2.5451	0.9643	2.8424
	-1-1-1-1	1	2.2224	1.0179	2.1834
		2	2.7592	1.0179	2.7108
		3	2.5451	0.9643	2.8424

(EX1013 at 45-46.)

Further, Appendix A highlights the PAP ratios of the added subcarriers in the last row of the table (namely, -1 -1 -1 -1) in “a red box” (shown above as a black box in the B&W reproduction of the Boer Provisional) to represent the lowest values of PAP ratio.

V. LEVEL OF ORDINARY SKILL IN THE ART

For purposes of this Preliminary Response only, Patent Owner adopts Petitioner's alleged definition. Should *inter partes* review be instituted, Patent Owner reserves the right to present an alternative definition for a person of ordinary skill in the art, along with any appropriate additional evidence.

VI. CLAIM CONSTRUCTION

In an *inter partes* review proceeding, “a claim of a patent . . . shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” 37 C.F.R. § 42.100(b).

The Petition alleges that no express constructions of the claims are necessary to assess whether the cited art reads on the challenged claims. (Pet. at 5-6.) For purposes of this Preliminary Response only, Patent Owner presents no express constructions of the claims. Patent Owner reserves the right to propose constructions of the claims should *inter partes* review be instituted.

VII. THE PETITION SHOULD BE REJECTED UNDER § 314(A) BECAUSE PETITIONER IS UNLIKELY TO PREVAIL WITH RESPECT TO ANY CHALLENGED CLAIM

Petitioner has not demonstrated that a POSITA would have found the challenged claims obvious over any of the combinations in Grounds 1 and 2.

As an initial matter, each of Petitioner's “Grounds” relies on at least four references. But Petitioner does not sufficiently identify a motivation to combine *each* of the references in its Grounds *with one another*. At best, Petitioner appears to assume that a mere possibility or suggestion of an approach suffices for obviousness. But this is legally insufficient as a matter of law. *Virtek Vision Int'l*,

97 F.4th at 888 (“It does not suffice to simply be known. A reason for combining must exist.”); *PersonalWeb*, 848 F.3d at 993-94 (it is not sufficient that “a skilled artisan, once presented with the two references, would have understood that they could be combined,” because “it does not imply a motivation to pick out those two references and combine them to arrive at the claimed invention.”); *Belden*, 805 F.3d at 1073 (“[O]bviousness concerns whether a skilled artisan not only *could* have made but *would have been motivated to make* the combinations or modifications of prior art to arrive at the claimed invention.”).

Each of Petitioner's Grounds fails for at least this reason.

A. Ground 1: Petitioner Has Failed to Show that Claims 1, 4, 8-23, and 27 Are Obvious over Jones, 802.11a, 802.11-1999, Zelst, and Boer under 35 U.S.C. § 103

With regard to claims 1, 4, 8-23, and 27, Petitioner has failed to show a reasonable likelihood that Jones, 802.11a, 802.11-1999, Zelst, and Boer render obvious each and every element of the challenged claims.

a) Claim 1 of the '629 patent:

At least the following limitations in claim 1 of the '629 patent are not taught by Jones, 802.11a, 802.11-1999, Zelst, or Boer, alone or in combination.

- i. 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**

Claim element 1[c] requires that the “Inverse Fourier Transformer” (IFT) processes the extended long training sequence from the signal generator.

First, neither Petitioner nor its expert have provided a construction of the phrase “processes,” or otherwise opined on its plain and ordinary meaning. Not surprisingly, Petitioner's arguments as to this element are superficial and conclusory:

The combination discloses “wherein the Inverse Fourier Transformer (IFFT) processes the extended long training sequence (Zelst 56-subcarrier ELTS) from the signal generator (Packet Formation block 314), and provides an optimal extended long training sequence with a minimal peak-to-average ratio (Zelst 56-subcarrier ELTS processed by the IFFT).” EX1005, ¶ 140.

As explained for limitation 1[b], in the combination, the IFFT processes Zelst's 56-subcarrier ELTS from the Packet Formation block 314. See [1a]. Thus, the only remaining issue for this limitation is whether the output of the IFFT is “an optimal extended long training sequence with a minimal peak-to-average ratio.”

(Pet. at 48-49.) (EX2001, ¶ 96.)

While the Petition purports to refer back to elements 1[a] and 1[b], those sections do not include any discussion of what it means to “process” the extended long training sequence. (Pet. at 40-45.) Therefore, the Petition does not identify *any* process in Jones, Zelst, 802.11a, or Boer performed by an IFT, or otherwise describe how any IFT in those references *processes* the extended long training sequence from the signal generator. Instead, Petitioner simply assumes that an IFT

must “process” an extended long training sequence. (EX2001, ¶ 97.). That unsupported assumption is not sufficient to find that Petitioner has met its burden with respect to this element in Ground 1.

Second, the Petition is entirely silent as to how any IFT in Jones, Zelst, 802.11a, or Boer “*provides*” an optimal extended long training sequence. Again, Petitioner assumes that the IFTs in the Ground 1 references must “provide” an “optimal extended long training sequence,” because Petitioner goes on instead to argue why such a sequence would be “optimal”:

As explained for limitation 1[b], in the combination, the IFFT processes Zelst’s 56-subcarrier ELTS from the Packet Formation block 314. See [1a]. Thus, the only remaining issue for this limitation is whether the output of the IFFT is “an optimal extended long training sequence with a minimal peak-to-average ratio.” *It is. Zelst’s 56-subcarrier ELTS is identical to the disclosed and claimed sequence and, therefore, the output of the IFFT for each sequence is identical. As discussed above for claim construction, the patent admits (and requires in the claim) that this is “optimal” and has a minimal PAPR.*

(Pet. at 49.) (EX2001, ¶ 98.)

Conspicuously absent from this analysis is an identification of any sequence “provided” by an IFT in Jones, Zelst, 802.11a, or Boer, or an explanation of why that *resultant* sequence at the *output* of the IFT is the claimed “optimal” sequence. Rather, the excerpt quoted above confirms Petitioner’s flawed analysis. For example, Petitioner admits that it is comparing the “56-subcarrier ELTS” it argues is shown in Zelst to the “disclosed and claimed sequence”—i.e., an “optimal

extended long training sequence.” However, Petitioner also asserts previously in the Petition that the alleged “Zelst 56-subcarrier ELTS” was generated by the *signal generator* in element 1[a]:

The combination discloses “*a signal generator* (Packet Formation block 314) *that generates* an extended long training sequence (*Zelst 56-subcarrier ELTS*).”

(Pet. at 40.)

Zelst and Jones emphasize the need to support legacy 802.11a devices, so it would have been obvious to use the same Packet Formation block 314 (*signal generator*) that generates the 802.11a LTS *to generate the improved Zelst 56-subcarrier ELTS*. EX1005, ¶ 131.

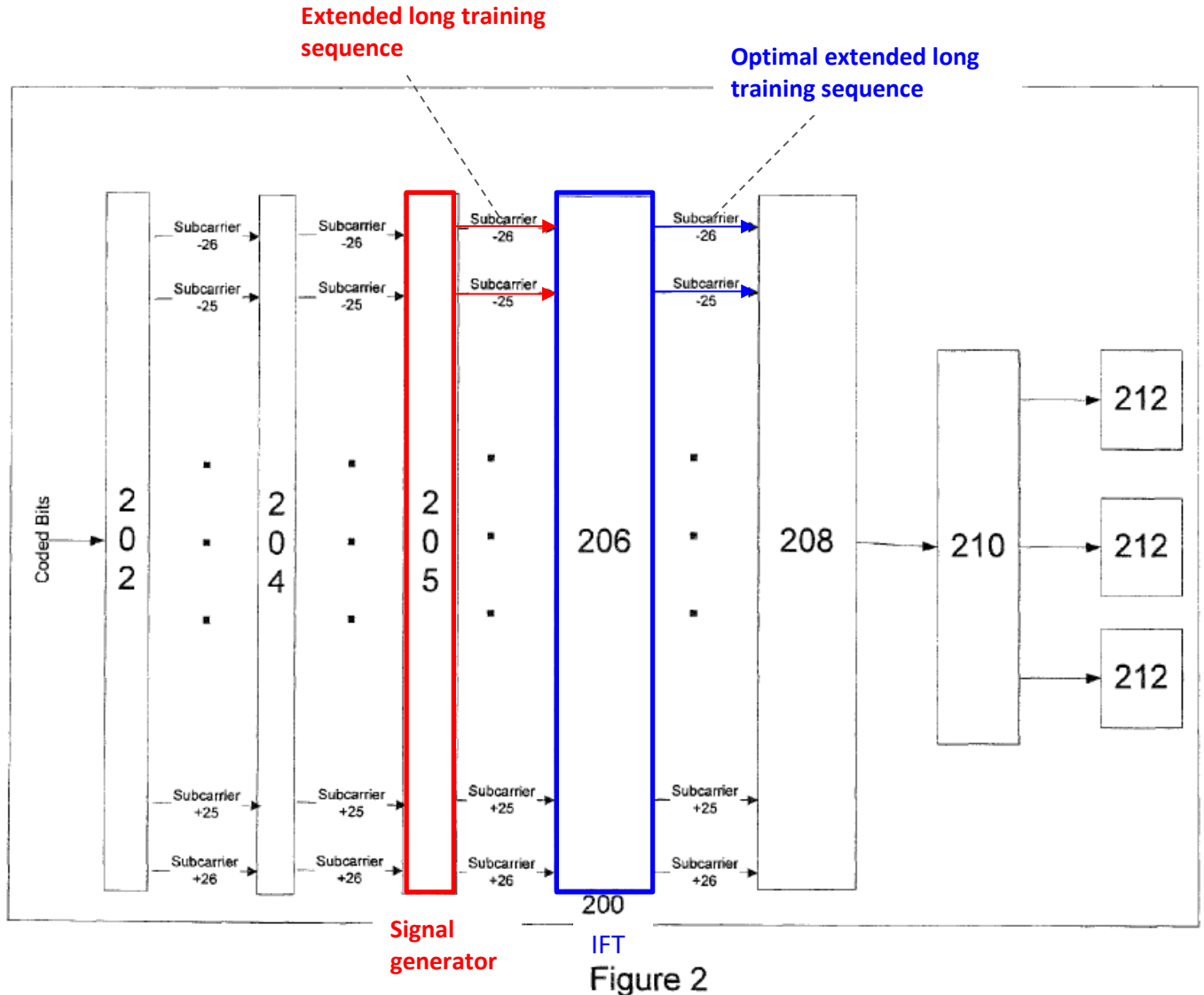
In the combination, it would have been obvious for Jones’s Packet Formation block 314 (*signal generator*) *to generate the Zelst 56-subcarrier ELTS* as taught by Zelst and Boer and zeros for the unused subcarriers. . . .

Thus, it would have been obvious to a POSITA that in the combination *the signal generator would generate the Zelst 56-subcarrier ELTS* that would be used, and zeros for the other subcarriers.

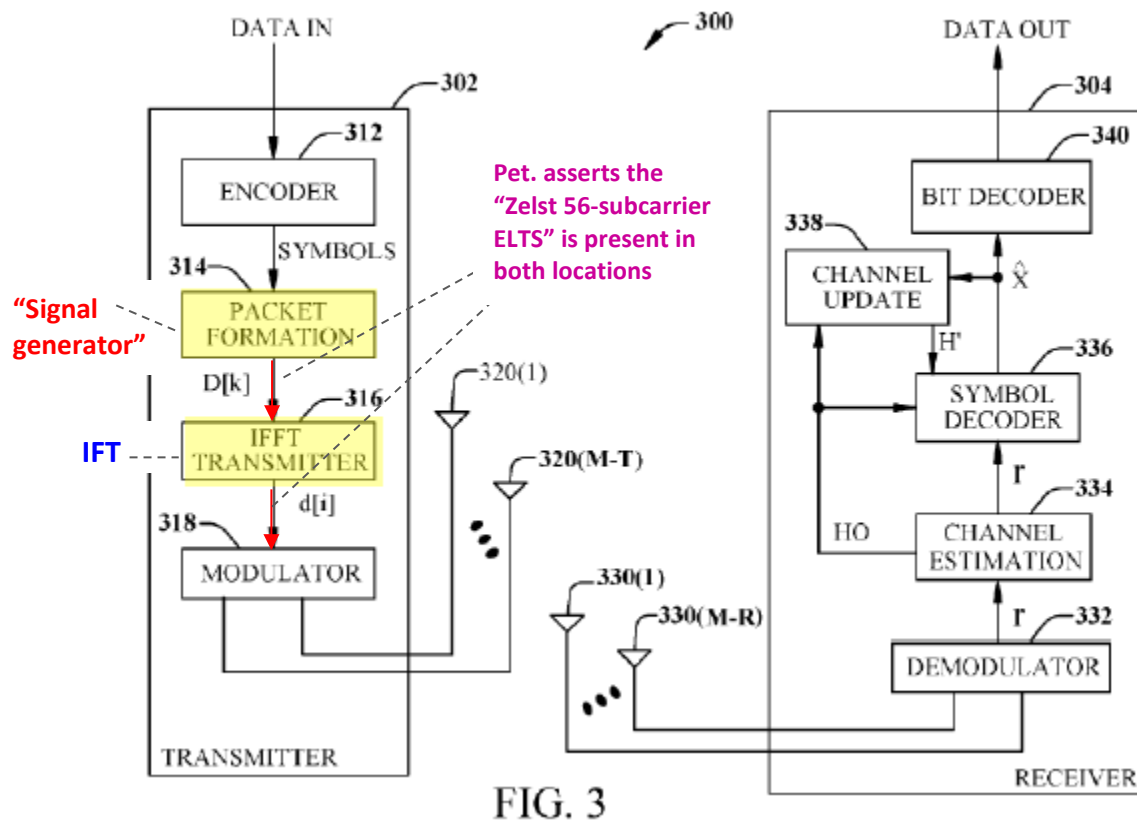
(Pet. at 44-45.) (EX2001, ¶¶ 98-99.)

In asserting that the alleged “Zelst 56-subcarrier ELTS” is both the output of the “signal generator” and the output of the IFFT, Petitioner conflates the claimed “extended long training sequence” with the claimed—but *different*—“optimal extended long training sequence,” without providing any argument or evidence as to why they can be conflated in this manner. (EX2001, ¶ 100.)

Petitioner's error is evident from the following figures from the '629 patent and the Ground 1 references, respectively, annotated for convenience. For example, in Fig. 2 of the '629 patent, the "signal generator" 205 generates an extended long training sequence (annotated in red). An Inverse Fourier Transformer 206 then "processes" the extended long training sequence from the signal generator 205 and provides an optimal extended long training sequence (annotated in blue):



(EX1001, Fig. 2 (annotated).) (EX2001, ¶ 101.). In contrast, below is Fig. 3 from Jones, annotated to depict Petitioner's proposal to use the "Packet Formation" block 314 and the "IFFT Transmitter" 316 to generate the alleged "Zelst 56-subcarrier ELTS" instead (see Pet. at 49):



(Pet. at 52, citing EX1014 Fig. 3 (highlighting by Petitioner; red annotations by Patent Owner).) (EX2001, ¶ 102.)

Dr. Buehrer's declaration does not fare any better, and simply parrots Petitioner's argument. (Pet. at 46 (citing EX1005, ¶ 135.). In asserting that that the "Zelst 56-subcarrier ELTS is generated by the Packet Formation" block 314 *and*

the “IFFT Transmitter” 316, Petitioner fails to identify any “process” performed by IFFT Transmitter 314, or identify any sequence “provided” by the IFFT Transmitter. Petitioner does not offer any other argument or evidence for this element. Therefore, the Petition fails to identify any evidence or argument that element 1[c] is present in the Ground 1 references.

Accordingly, Ground 1 fails.

ii. 1[e] wherein the optimal extended long training sequence is carried by exactly 56 active sub-carriers

Claim element 1[e] requires that the “optimal extended long training sequence is carried by exactly 56 active sub-carriers.” No more, and no fewer. While Petitioner advances several arguments that the Ground 1 references teach or suggest this element, its arguments are all factually unsupported, resulting in a legally deficient obviousness analysis.

a. Zelst Does Not Teach or Suggest Using a 56-Subcarrier Extended Long Training Sequence

First, throughout the Petition, Petitioner refers to a “Zelst 56-subcarrier ELTS,” suggesting that Zelst (i.e., the Zelst non-provisional patent, EX1010) teaches the actual element claimed in 1[e]. However, Petitioner also acknowledges that it derives the purported “Zelst 56-subcarrier ELTS” by “simply truncat[ing]” seven subcarriers from the actual sequences taught by Zelst and Jones:

To arrive at the '629 patent's encoding sequence for 56 subcarriers, *a POSITA would simply truncate the 63-subcarrier sequence taught by Jones and Zelst so as not to use*

the seven sub-carriers at the highest and lowest frequencies; i.e., sub-carriers -32, -31, -30, -29, +29, +30 and +31. As taught by Jones, those subcarriers would be set to zero by the signal generator. Put another way, *only the middle 56 subcarriers from -28 to +28 would be used.* EX1005, ¶ 95.

(Pet. at 28.)

As Petitioner admits, Zelst teaches extending the 52-subcarrier legacy long training sequence in 802.11a to use 63 active subcarriers, *not* 56 subcarriers as claimed by the '629 patent. In response, Petitioner “highlights” 56 subcarriers near the middle of this 63-subcarrier extended sequence in an attempt to replicate the claimed element of 56 active subcarriers:

Figure 15A of Zelst (below, annotated) has its center 56 values highlighted. The same encoding sequence is disclosed in Jones and the Zelst Provisional, which is shown (annotated) immediately below Figure 15A in Zelst. EX1005, ¶ 91.

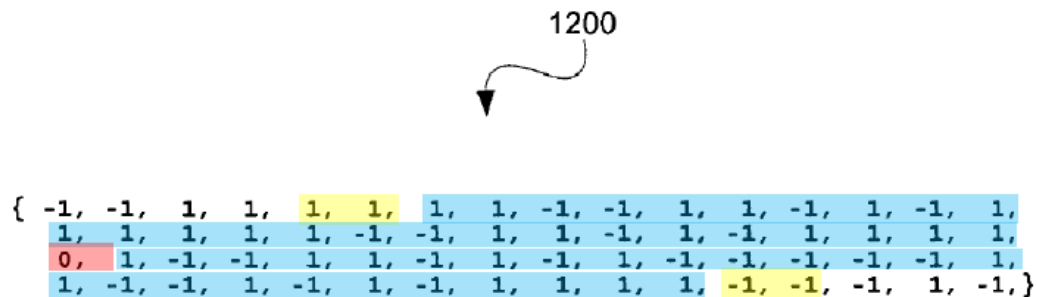


FIG. 15A

(Pet. at 25, citing EX1010 Fig. 15A (highlighted in Pet.)) Petitioner similarly highlights a corresponding 63-subcarrier sequence in the Zelst provisional (EX1011):

20 MHz & 40 MHz Extended Long Training (ELT)

- ELT for 20 MHz:

$L_{-32,31} = \{-1, -1, 1, 1, 1, 1, 1, 1, -1, -1, 1, 1, -1, 1, -1, 1, 1, 1, 1, 1, -1, -1, 1, 1, -1, 1, -1, 1, 1, 1, 1, 1, 0, 1, -1, -1, 1, 1, -1, 1, -1, 1, -1, -1, -1, -1, -1, 1, 1, -1, -1, 1, -1, 1, -1, 1, 1, 1, 1, -1, -1, -1, 1, -1\}$

(Pet. at 25, citing EX1011 at 4.) Petitioner again asserts that “[t]hese highlighted sequences in Zelst and the Zelst Provisional are identical to the 56 values disclosed and claimed in the ’629 patent (and Jones) for the same subcarriers.” (Pet. at 25.) However, Petitioner’s only stated basis for selectively truncating and highlighting 56 subcarriers out of 63 in this manner is “to allow for coexistence and interoperability [aka backwards compatibility]”:

It would have been obvious for a POSITA to only use the middle 56 subcarriers from the Jones and Zelst sequence because, *as the title of Zelst explains, the goal is “to allow for coexistence and interoperability [aka backwards compatibility] between 802.11a devices and higher data rate ... devices.”* EX1010, Title. Jones explains the same goal. EX1014, 8:37-40. . . . In other words, maintain the same encoding sequence as the legacy 802.11a standard for the center 52 subcarriers. EX1005, ¶ 96.

(Pet. at 28-29.)

Petitioner does not attempt to explain why a POSITA would have been motivated to “truncate” seven subcarriers out of 63, or to achieve “coexistence and interoperability.” For example, Petitioner does not argue, or cite any evidence, that

maintaining “coexistence and interoperability [aka backwards compatibility]” mandates either truncating a 63-subcarrier sequence to 56, or extending the conventional 52-subcarrier sequence to use 56 subcarriers. Instead, Petitioner simply assumes these non-obvious possibilities. (EX2001, ¶ 110.)

Moreover, Petitioner does not explain why a POSITA would have found it obvious, based merely on Zelst's mention of a “modified preamble,” to use a **56-subcarrier** long training sequence in said “modified preamble:”

Zelst explains to achieve this, “[i]n some embodiments, *the modified preamble includes both legacy 802.11a Sequences as well as modified preamble Sequences.*” *Id.*, 3:3-5. *In other words, maintain the same encoding sequence as the legacy 802.11a standard for the center 52 subcarriers.* EX1005, ¶ 96.

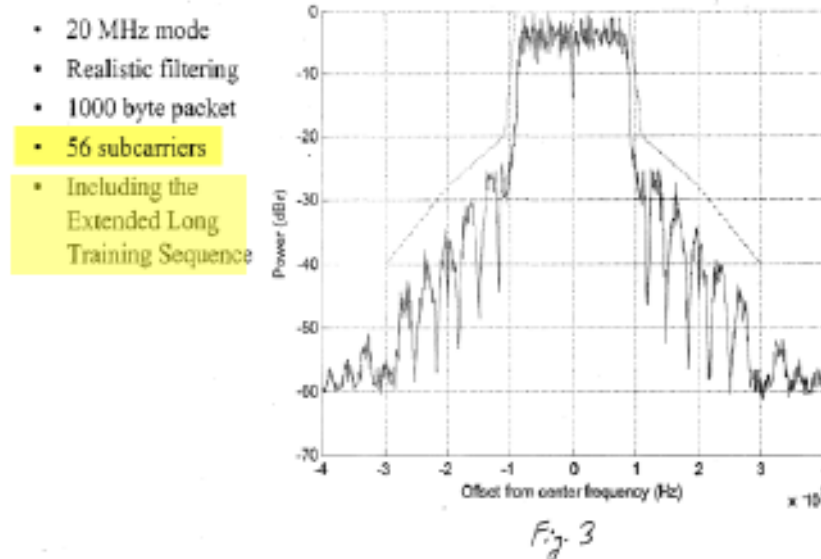
(Pet. at 28-29.) Petitioner's argument that Zelst supports this is a complete non sequitur, since as explained above, Zelst teaches extending the 52-subcarrier legacy long training sequence in 802.11a to use 63 active subcarriers, **not** 56 subcarriers as claimed by the '629 patent... (EX2001, ¶ 111.)

Dr. Buehrer's declaration is likewise silent on any reason a POSITA would think to “truncate” the 63-subcarrier sequence from Zelst and/or Jones to achieve the claimed 56-subcarrier extended long training sequence. Petitioner therefore pivots to a statement in the Zelst Provisional (EX1011) purporting to describe “56 subcarriers.” Specifically, Petitioner asserts:

Although the above sequences in Zelst and the Zelst Provisional disclose 64 subcarriers, the Zelst Provisional also discloses the use of exactly 56 subcarriers for the extended long training

sequence. Figure 3 of the Zelst Provisional (annotated below), recommends 56 subcarriers “Including the Extended Long Training Sequence.” EX1005, ¶ 93.

Example PSD of TX Signal



EX1011, FIG. 3. Zelst Provisional explains the reason for the extended long training sequence is “to prevent interpolation issues.” Id., 2, 9, 13. The same rationale for extending the number of subcarriers to 56 is disclosed in Boer. EX1012, 4:1-59; EX1005, ¶ 94.

(Pet. at 27-28, citing EX1011 at 8.) However, neither Fig. 3 nor any of the other disclosures in the Zelst Provisional shows that the “56 subcarriers” referenced on page 8 could be used to carry an optimal extended long training sequence, as the claim requires. Petitioner merely assumes they could. (EX2001, ¶¶ 113-114.). But Petitioner’s assumption is unsupported by the actual teachings of the Zelst Provisional and Zelst.

For example, the Zelst Provisional clarifies that the “[l]ong training symbol is *identical* to that of 802.11a [i.e., using 52 subcarriers] with addition of out-of-band pilots.” (EX1011 at 7.) However, as Petitioner concedes, these additional out-of-band pilots “will be *significantly attenuated by TX filtering*, so they do not add significantly to the power of the long training symbol, nor affect the spectral mask.” (*Id.* at 7; Pet. at 33.) In other words, the Zelst Provisional does not regard 56 subcarriers as a suitable choice for the extended long training sequence due to significant attenuation, and proposes only 63- or 127-subcarrier sequences. (*See* EX1011 at 6.) And besides the paltry disclosure from Fig. 3 of the Zelst Provisional, neither Petitioner nor its expert identify any other teaching or suggestion in the Zelst Provisional of using 56 subcarriers for any purpose. (EX2001, ¶¶ 115-117.)

Nor is there any teaching in the Zelst patent (EX1010) itself of using 56 subcarriers for *any* purpose. The Zelst Provisional explains that 56 subcarriers would be attenuated. However, the Zelst patent describes the importance of using *unattenuated* subcarriers. Accordingly, Zelst goes on to teach algorithms and techniques for using **64** subcarriers efficiently to increase the data rate:

FIG. 5 illustrates the case where out-of-band pilots are attenuated for 20 MHz channels used to transmit a MIMO signal. The preamble structure can be identical to a conventional 802.11a preamble, except that the long training symbol sequence may use what are otherwise considered out-of-band subcarriers. Some or all of these out-of-band subcarriers may also be used in the data symbols to increase the

data rate.

...

If two adjacent channels are used simultaneously by one device, then there is no need to attenuate the “out-of-band subcarriers” in the middle of this 40 MHz band. An example of this is shown in FIG. 6. ***The out-of-band subcarriers that are in between the two 20 MHz channels thus need not be attenuated.***

...

With unattenuated out-of-band subcarriers, signaling information can be carried on those subcarriers during packet setup, such as signaling operating and/or extension modes during a preamble, and additional data can be carried on those subcarriers, to increase the data rate.

(EX1010 at 7:26-58.)

By allowing for channel estimation for multiple transmitters, MIMO or space-time coding techniques can be supported to achieve 802.11a extensions. ***One way to do this is by sending a different set of subcarriers from each transmitter. As an example, for the case of two transmitters, a device might modulate its OFDM subcarriers with the 64 values of L_3 , shown in FIG. 4, where one transmitter transmits the odd subcarriers $\{1, 3, \dots, 63\}$ and the other transmitter transmits the even subcarriers $\{0, 2, \dots, 62\}$.*** Thus, one transmitter would take an IFFT of the odd subcarriers and transmit samples of that time varying signal and the other transmitter would take an IFFT of the even subcarriers and transmit samples of that time varying signal.

(EX1010 at 5:53-65.)

In this method, enough of the signal is received to identify what should be the two repeated long training symbols, ***typically sampled as two identical repetitions of 64 samples for each receive antenna. An FFT (fast-Fourier transform) of the sum of the two identical repetitions of 64 samples is taken, generating an output sequence $s_i(k)$, comprising 64 complex***

values per receive antenna, containing channel amplitudes and phases, as well as phase shifts caused by the long training symbol sequence that was actually used (e.g., sequences such as L_1 , L_2 , L_3 or L_4).

From the output sequence $s_i(k)$, the receiver generates two other sequences, $r_s(k)$ and $r_m(k)$, by multiplying $s_i(k)$ by the sequences L_2 and L_3 for each receive antenna i , as illustrated by Equations 3a and 3b.

$$r_{si}(k) = \sum_{k=0}^{63} S_i(k) L_2(k) \quad (\text{Equ. 3a})$$

$$r_{mi}(k) = \sum_{k=0}^{63} S_i(k) L_3(k) \quad (\text{Equ. 3b})$$

(EX1010 at 6:41-64.). (EX2001, ¶ 118.)

The above disclosures from Zelst demonstrate that even if the Zelst inventors had considered using 56 subcarriers as a possibility at the time of the Zelst Provisional (which has not been shown), the lack of corresponding disclosure in the subsequent *non-provisional* application demonstrates the inventors rejected that possibility, and opted for a different solution—specifically, the 64-subcarrier sequence described in Fig. 15A of Zelst (and on page 6 of the Zelst Provisional). Stated differently, Zelst itself teaches away from the Zelst Provisional's suggestion of using 56 subcarriers, likely because using 56 subcarriers was not the best mode for the inventions of Zelst. Therefore, a POSITA reviewing both Zelst and the Zelst Provisional would not be motivated to modify (or “truncate”) the 63-

subcarrier extended long training sequence of Zelst to use only 56 subcarriers.

(EX2001, ¶¶ 119-120.)

Moreover, Petitioner fails to show that Fig. 15A of Zelst, even if truncated as Petitioner suggests, is “an optimal extended long training sequence with a minimal peak-to-average ratio,” as required by element 1[c]. There is simply no disclosure in Zelst that a truncated *portion* of the sequence of Fig. 15A is “optimal” or has a “minimal peak-to-average ratio.” Nor do Petitioner and Dr. Buehrer offer any reason why truncating a sequence would necessarily result in the resulting sequence having the same peak-to-average ratio as a sequence that was not truncated. (EX2001, ¶ 121.)

For the above reasons, Petitioner's assertion that “a POSITA would simply “truncate” a 63-subcarrier sequence so as not to use the seven sub-carriers at the highest and lowest frequencies,” (Pet. at 28), is not merely unsupported, but actually contradicted by the actual teachings of Zelst. (EX2001, ¶ 122.). Petitioner therefore fails to demonstrate obviousness based on Zelst. *See Belden*, 805 F.3d at 1073 (“[O]bviousness concerns whether a skilled artisan not only *could have made* but *would have been motivated to make* the combinations or modifications of prior art to arrive at the claimed invention.”). Instead, Petitioner's proposed “truncation” theory amounts to nothing more than hindsight analysis, which is improper. *Ortho-McNeil Pharm.*, 520 F.3d at 1364 (Obviousness must be measured “*at the time the invention was made.*”); *Apple*, IPR2015-00442, Paper 9

at 15, 17 (A petition must demonstrate a rationale to modify or combine prior art references without relying on the patent disclosure itself); *ActiveVideo Networks*, 694 F.3d at 1327 (“[T]he expert’s testimony on obviousness was essentially a conclusory statement that a person of ordinary skill in the art would have known, based on the ‘modular’ nature of the claimed components, how to combine any of a number of references to achieve the claimed inventions. This is not sufficient and is fraught with hindsight bias.”); *In re NTP*, 654 F.3d at 1299 (“Care must be taken to avoid hindsight reconstruction by using ‘the patent in suit as a guide through the maze of prior art references, combining the right references in the right way so as to achieve the result of the claims in suit.’”).

b. Jones Suffers from the Same Deficiencies as Zelst

Petitioner offers no substantive analysis of Jones for element 1[e] that is not cumulative of its analysis of Zelst. (*See, e.g.*, Pet. at 28-35 (“[A] POSITA would simply truncate the 63-subcarrier sequence taught by Jones and Zelst”; “It would have been obvious for a POSITA to only use the middle 56 subcarriers from the Jones and Zelst sequence”; “Zelst and Jones expressly teach . . .”; “. . . as taught in Zelst and Jones”). But as explained above, Zelst does not teach using exactly 56 subcarriers for any purpose, let alone to carry an optimal extended long training sequence, as required by the ‘629 patent. (EX2001, ¶ 123).

c. Petitioner’s 802.11a “Spectral Mask” Argument Does Not Show Obviousness

Likely recognizing the deficiencies in its analysis of Jones and Zelst, Petitioner proposes a different obviousness theory entirely as to 802.11a. Specifically, Petitioner asserts that “56 subcarriers could be used to carry the ELTS based on the room available in the 802.11a spectral mask.” (Pet. at 31.)

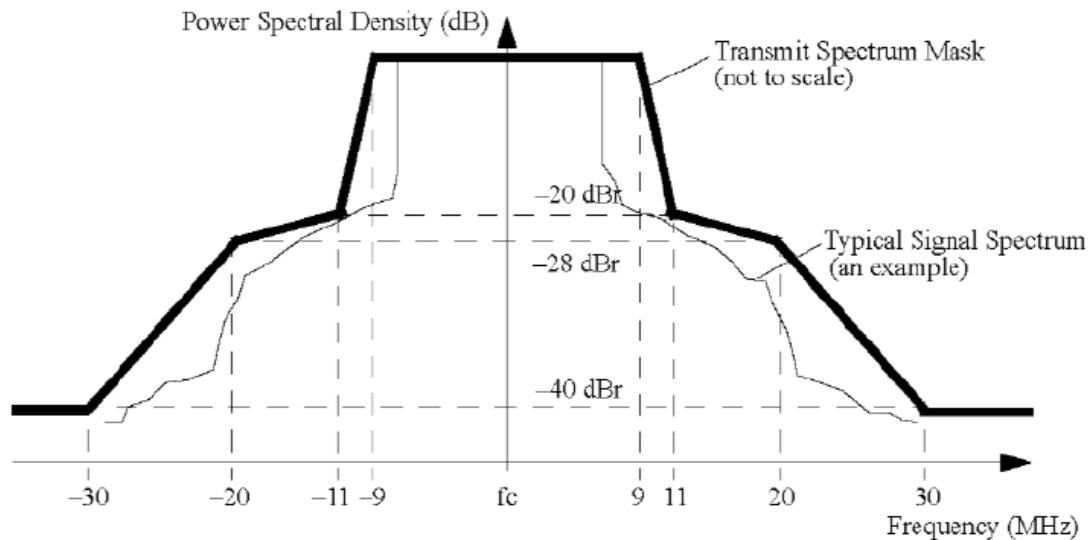


Figure 120—Transmit spectrum mask

(Pet. at 31, citing EX1008, FIG. 120.) (EX2001, ¶ 124).

In connection with the “spectral mask” reproduced above, Petitioner elaborates:

802.11a states the “[t]he transmitted spectrum shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth not exceeding 18 MHz” and that “[t]he transmitted spectral density of the transmitted signal shall fall within the spectral mask, as shown in Figure 120.” EX1008, 28. 802.11a further states that the subcarrier frequency spacing is “**0.3125 MHz (=20 MHz/64).**” Id., 9. A POSITA would have understood the spectral mask’s 0dBr bandwidth of 18 MHz could fit up to 57.6 subcarriers, because $18 \text{ MHz} / 0.3125 \text{ MHz} = 57.6$. EX1005, ¶ 100.

(Pet. at 31 (red, blue, and bold annotations by Patent Owner).) (EX2001, ¶ 124).

This is incorrect. A person of skill in the art would have understood that the non-linearity of the analog front-end (including notably the digital-to-analog converter and the power amplifier) would have had a major impact on the bandwidth being used. Nonlinear elements increase the occupied bandwidth. Due to the additional spectral components generated by the nonlinearities, contrary to what the Petition claims, a person of skill in the art would have understood that 57 subcarriers would NOT have 0 dBr bandwidth of 18 MHz. A POSITA would have understood that the bandwidth would have been more than 18 MHz, resulting in violation of the spectral mask. (EX2001, ¶ 125).

Moreover, Zelst and Jones easily disprove Petitioner's assumption that the numerator in its calculation must be 18 MHz. For example, both Zelst and Jones teach the use of a **20 MHz** window (i.e., from -10 to +10 MHz), not an 18 MHz one:

By convention, used here, the first value in the sequence L1 is the value for the DC subcarrier (index $k=0$), followed by the value for the 1×312.5 kHz subcarrier, then the value for the $2 \times 312.5 = 625$ kHz subcarrier, etc., ***up to the 32nd value for the $31 \times 312.5 \text{ kHz} = 9687.5 \text{ kHz}$ subcarrier. The 33rd value corresponds to the -10 MHz subcarrier,*** followed by the $-(10 \text{ MHz} - 312.5 \text{ kHz})$ subcarrier, and so on, with the 64th (index $k=63$) value corresponding to the -312.5 kHz subcarrier.

(EX1014 at 2:19-27; EX1010 at 2:19-27.) Therefore, Petitioner's reliance on the 802.11a spectral mask as a basis for obviousness is not only mathematically

flawed, but also inconsistent with its other Ground 1 references. (EX2001, ¶¶ 126-127).

d. Petitioner Does Not Rely on Boer for this Element in Ground 1

In Ground 1, Petitioner does not rely on Boer for teaching element 1[e]. (See Pet. at 51.) Instead, Petitioner relies on Boer for element 1[e] in Ground 2:

In Ground 1, Petitioner relied on Zelst and Boer's teaching that exactly 56 subcarriers should be used as required by [1e] and Zelst and Boer's teaching (with Jones) of the precise encodings required by [1f]. Petitioner referred to this ELTS as the "Zelst 56-Subcarrier ELTS" to distinguish Grounds 1 and 2. Here, in Ground 2, Petitioner relies on Boer's teachings (in addition to Jones) and so Petitioner refers to the ELTS as the "Boer 56-Subcarrier ELTS" to distinguish from Ground 1. EX1005, ¶ 206.

(Pet. at 74.)

Therefore, for element 1[e], Patent Owner will address Boer in Ground 2. To the extent the Board is inclined to consider Boer for element 1[e] in Ground 1, Patent Owner incorporates its arguments from Ground 2 below.

- iii. 1[f]: represented by encodings for indexed sub-carriers -28 to +28, excluding indexed sub-carrier 0 which is set to zero, as follows:**

<i>Sub-carrier</i>	-28	-27	-26	-25	-24	-23	-22
<i>Encoding</i>	+1	+1	+1	+1	-1	-1	+1
<i>Sub-carrier</i>	-14	-13	-12	-11	-10	-9	-8
<i>Encoding</i>	+1	+1	+1	-1	-1	+1	+1
<i>Sub-carrier</i>	1	2	3	4	5	6	7
<i>Encoding</i>	+1	-1	-1	+1	+1	-1	+1
<i>Sub-carrier</i>	15	16	17	18	19	20	21
<i>Encoding</i>	+1	+1	-1	-1	+1	-1	+1
<i>Sub-carrier</i>	-21	-20	-19	-18	-17	-16	-15
<i>Encoding</i>	+1	-1	+1	-1	+1	+1	+1
<i>Sub-carrier</i>	-7	-6	-5	-4	-3	-2	-1
<i>Encoding</i>	-1	+1	-1	+1	+1	+1	+1
<i>Sub-carrier</i>	8	9	10	11	12	13	14
<i>Encoding</i>	-1	+1	-1	-1	-1	-1	-1
<i>Sub-carrier</i>	22	23	24	25	26	27	28
<i>Encoding</i>	-1	+1	+1	+1	+1	-1	-1

Claim element 1[f] requires that the “optimal extended long training sequence” is represented by the precise subcarrier encodings denoted above. None of the Ground 1 references, individually or combination, teach this element. Petitioner’s arguments are therefore again based on a flawed obviousness analysis.

a. *Neither Jones nor Zelst Teaches this Element
Because Neither Reference Teaches a 56-
Subcarrier Sequence*

Petitioner first asserts that a 63-subcarrier sequence taught by Zelst and Jones, selectively highlighted (or truncated) to include only subcarriers -28..-1 and 1..28, renders this element obvious because the highlighted subcarriers correspond to the subcarrier encodings claimed in element 1[f]:

Jones at Figure 4 discloses the claimed sequence as part of L2, which is annotated below to highlight sub-carrier 0 in red (set to zero), highlight the 52-subcarriers of the legacy 802.11a LTS in blue, and

(Obviousness must be measured “*at the time the invention was made.*”); *Apple*, IPR2015-00442, Paper 9 at 15, 17 (A petition must demonstrate a rationale to modify or combine prior art references without relying on the patent disclosure itself); *ActiveVideo Networks*, 694 F.3d at 1327 (“T]he expert’s testimony on obviousness was essentially a conclusory statement that a person of ordinary skill in the art would have known, based on the ‘modular’ nature of the claimed components, how to combine any of a number of references to achieve the claimed inventions. This is not sufficient and is fraught with hindsight bias.”); *In re NTP*, 654 F.3d at 1299 (“Care must be taken to avoid hindsight reconstruction by using ‘the patent in suit as a guide through the maze of prior art references, combining the right references in the right way so as to achieve the result of the claims in suit.’”).

b. *Boer Teaches Away from the Claimed Subcarrier Sequence*

Petitioner’s only remaining argument is that Boer (and the Boer Provisional) teach the claimed sequence. (Pet. at 55, citing EX1013 at 45.) But Petitioner misapprehends the explicit teachings of Boer, and a closer review of Boer and the Boer Provisional demonstrates that Boer *teaches away* from the claimed subcarrier encoding sequence. (EX2001, ¶ 132).

Petitioner first asserts that Boer and the Boer Provisional each separately disclose extending the 802.11a long training sequence with four additional subcarriers, for a total of 56 subcarriers:

Boer discloses an extended long training sequence, stating: “since the training technique defined by the IEEE 802.11a/g standard only modulates 52 out of the 64 subcarriers, additional spectrum is available to specify additional subcarriers. For example, it can be shown that the addition of four extra training subcarriers, two at each side of the spectrum, conforms with the IEEE 802.11a/g transmit mask defined in the IEEE 11a/g standard.” EX1012, 4:40-48; EX1005, ¶ 101.

...

The Boer Provisional also teaches that adding four subcarriers to 802.11a still complies with 802.11a's spectral mask: “As can be seen from Figure 5 [below], the PSDs of the training sequences still fulfill the transmit spectral mask requirements, when extended with four additional subcarriers. From this it can be concluded that the extension with extra subcarriers at the edge is allowed and is in line with the IEEE 802.11a specifications.”

(Pet. at 31-32, citing EX1012, EX1013.). (EX2001, ¶ 133). Petitioner argues that there are only 16 possible combinations of subcarrier encodings for these four added subcarriers, that the Boer Provisional explicitly disclosed all 16 combinations, and the claimed sequence would therefore have been obvious:

The Boer Provisional explicitly disclosed all 16 of the possible encodings for the additional 4 subcarriers. Id., 45-46 (including (1,1,-1,-1), the encoding claimed in the '629 patent for the 4 new subcarriers). EX1005, ¶ 73.

(Pet. at 18.)

The Boer Provisional discloses 56 subcarriers should be used to enhance channel estimation, and that there are only 16 possible encoding schemes when adding four subcarriers to the 52 subcarriers already present in 802.11a. That is, since each subcarrier can be encoded using either a +1 or -1, there are only two possibilities per subcarrier, and $2^4=16$. All 16 possibilities are disclosed in the Boer Provisional, one of which (highlighted below) is the same encoding disclosed in Zelst and claimed in the '629 patent.

(Pet. at 29.). (EX2001, ¶ 134). Petitioner specifically cites a table purporting to show the claimed sequence (1, 1, -1, -1) of the four added subcarriers in Boer. An excerpt from that table is reproduced below, annotated by Petitioner:

Diagonal-4	1111	1	2.9337	1.0179	2.8822
		2	4.3393	1.0179	4.2632
		3	2.7409	0.9643	2.8424
	111-1	1	2.9337	1.0179	2.8822
		2	4.3393	1.0179	4.2632
		3	2.7409	0.9643	2.8424
	11-11	1	3.0600	1.0179	3.0063
		2	4.3393	1.0179	4.2632
		3	2.7409	0.9643	2.8424
	11-1-1	1	3.0600	1.0179	3.0063
		2	4.3393	1.0179	4.2632
		3	2.7409	0.9643	2.8424
	1-111	1	2.9337	1.0179	2.8822
		2	3.0265	1.0179	2.9734
		3	2.7409	0.9643	2.8424
	1-11-1	1	2.9337	1.0179	2.8822
		2	2.7592	1.0179	2.7108
		3	2.7409	0.9643	2.8424
	1-1-11	1	3.0600	1.0179	3.0063
		2	3.0265	1.0179	2.9734
		3	2.7409	0.9643	2.8424
	1-1-1-1	1	3.0600	1.0179	3.0063
		2	2.7592	1.0179	2.7108
		3	2.7409	0.9643	2.8424
	-1111	1	2.6520	1.0179	2.6055
		2	4.3393	1.0179	4.2632
		3	2.7409	0.9643	2.8424
	-111-1	1	2.6520	1.0179	2.6055
		2	4.3393	1.0179	4.2632

EX1013, 45; EX1005, ¶ 97.

(Pet. at 30, citing EX1013 at 45.) (EX2001, ¶ 135). However, Petitioner

misapprehends the actual teachings of the Boer Provisional, and Petitioner's

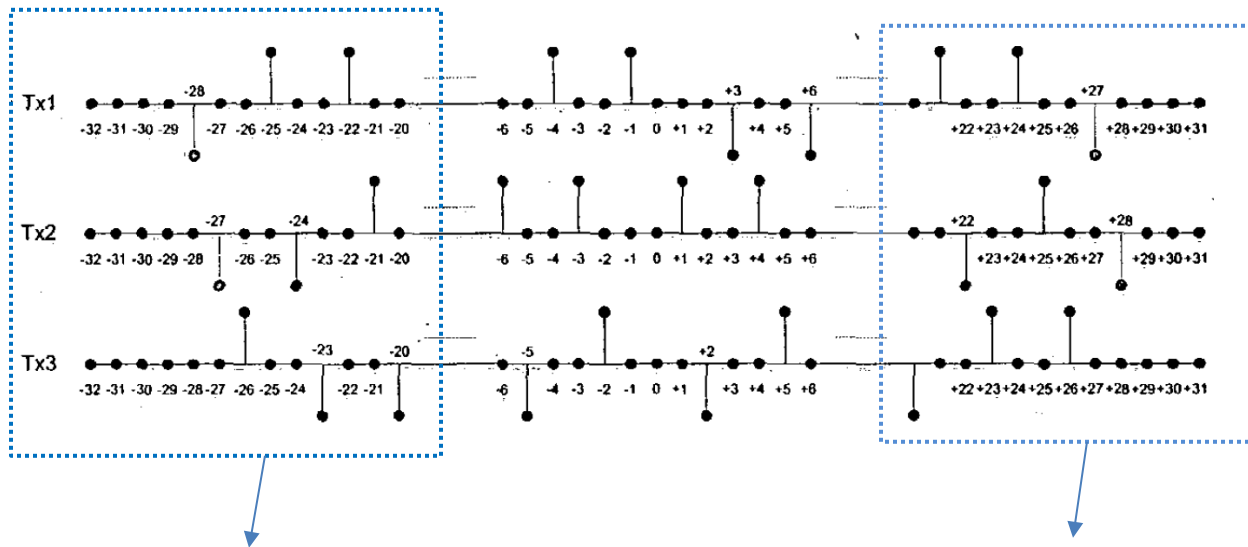
arguments based on Boer are wrong for at least two reasons.

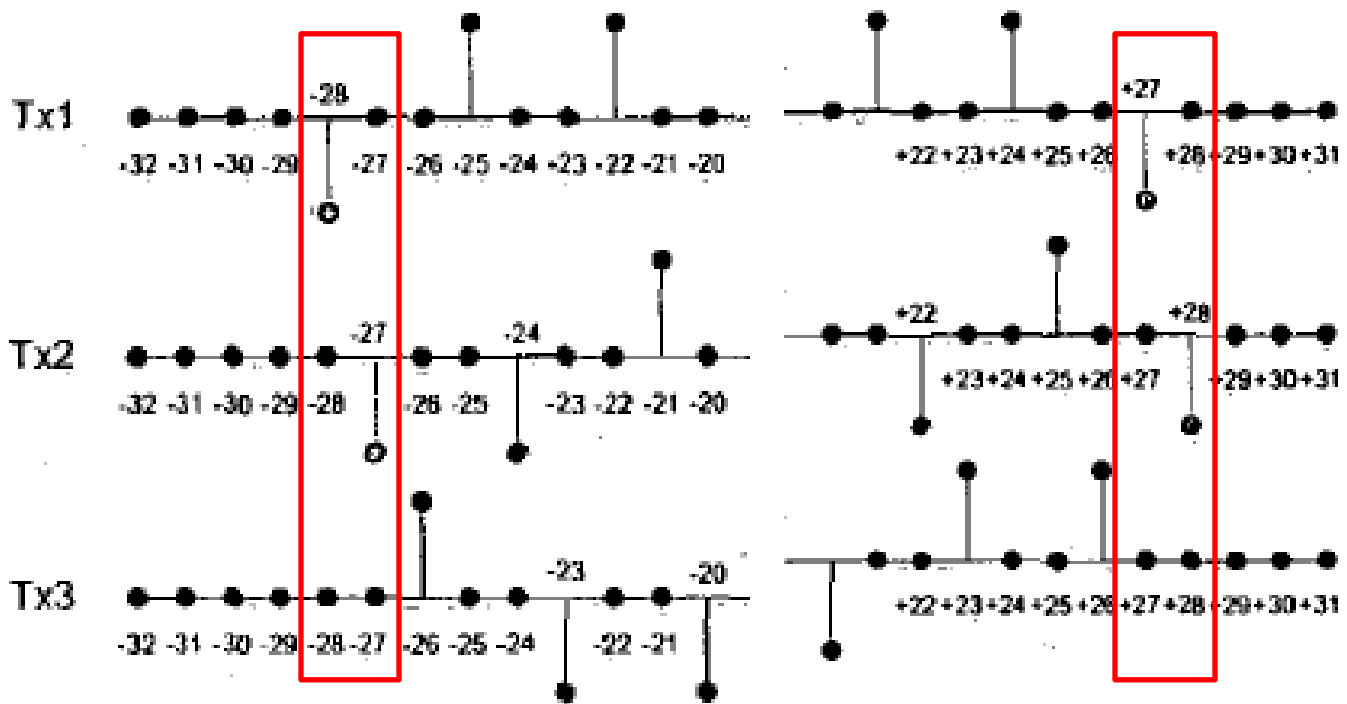
First, the Boer Provisional teaches a specific scheme of adding subcarriers at the spectrum's edges to achieve "the most efficient training of a MIMO-OFDM system":

Figure 2 gives a schematic representation of the MIMO-OFDM long training symbols *for a 3 transmit antenna system*, with additional subcarriers at the spectrum's edges. The extra subcarriers at the edges (red) are modulated in such a way that the peak-to-average power ratio (PAP) is lowest. Simulation results are given in the Appendix, Chapter 4.

(EX1013 at 3-5.) (EX2001, ¶ 137).

Figure 2 of the Boer Provisional is reproduced below, with subcarrier numbers -28, -27, 27 and 28 magnified and annotated for clarity:





(EX1013 at 5 (magnified and annotated).) (EX2001, ¶ 138).

The Boer Provisional does not teach the use of 56 *active* subcarriers. As the red boxes in (annotated and magnified Fig. 2 show), none of the sequences transmitted on antennas Tx1, Tx2, and Tx3 use all four additional subcarriers required by the claim, namely, -28, -27, 27, and 28; rather, in all of the transmitted sequences, at least two are *inactive*. For example, the sequence on Tx3 does not use these subcarriers at all, because subcarriers -28, -28, 27 and 28 are all zeros. And the sequences transmitted on Tx1 and Tx2 use *two* additional subcarriers, at best (the other two are zeros, or inactive). The sequence on Tx1 adds only active subcarriers -28 and +27, while the sequence on Tx2 adds only active subcarriers -

27 and +28. Therefore, nothing in Fig. 2 shows the use of four additional active subcarriers, as required by the claim. (EX2001, ¶¶ 139-141).

Second, to the extent it is argued that inserting additional subcarriers at all of the -28, -27, 27, and 28 subcarrier numbers would have been obvious, Petitioner is nevertheless wrong that its cited table renders obvious the claimed subcarrier sequence. The Boer Provisional provides context for the excerpt reproduced by Petitioner, and explains that the complete table (in Appendix A) should be used by a POSITA to determine the subcarrier encodings with the lowest peak-to-average power (PAP) ratio. (EX1013 at 29.) The Boer Provisional goes on to state:

*“Preferably the training sequence **with lowest PAP ratio** is used”:*

5 PAP-ratio

An important feature of the 11a long training sequences is the low Peak-to-Average Power (PAP) ratio. This minimizes the effect of non-linearity of the PA and prevents clipping in the receiver's ADs. This section looks at the PAP ratios of the original 11a training sequence and the diagonally loaded training sequences for two or three transmit antennas and with zero, two or four additional subcarriers.

The PAP ratios for these training sequences are given in Appendix A. The training sequences with the lowest PAP ratios are listed in a red box. Preferably the training sequence with lowest PAP ratio is used.

(EX1013 at 29 (annotated).) (EX2001, ¶¶ 142-143). The entirety of Appendix A, which Petitioner did not reproduce, shows the PAP ratios for each of the 16 possible combinations of four additional subcarriers:

Appendix A: PAP ratios training sequences

	Xtra Bits	Antenna	Max Power	Mean Power	PAP
802.11a	0	1	4.1458	2.0000	2.0729
Diagonal-0	0000	1	4.0101	1.0000	4.0101
		2	3.8462	1.0000	3.8462
	0000	1	2.9518	1.0385	2.8424
		2	2.2940	0.9808	2.3390
		3	2.8269	0.9808	2.8824
Diagonal-2	0110	1	4.4815	1.0000	4.4815
		2	4.4815	1.0000	4.4815
	01-10	1	4.4815	1.0000	4.4815
		2	4.5817	1.0000	4.5817
	0-110	1	3.0000	1.0000	3.0000
		2	4.4815	1.0000	4.4815
	0-1-10	1	3.0000	1.0000	3.0000
		2	4.5817	1.0000	4.5817
Diagonal-4	1111	1	2.9337	1.0179	2.8822
		2	4.3393	1.0179	4.2632
		3	2.7409	0.9643	2.8424
	111-1	1	2.9337	1.0179	2.8822
		2	4.3393	1.0179	4.2632
		3	2.7409	0.9643	2.8424
	11-11	1	3.0600	1.0179	3.0063
		2	4.3393	1.0179	4.2632
		3	2.7409	0.9643	2.8424
	11-1-1	1	3.0600	1.0179	3.0063
		2	4.3393	1.0179	4.2632
		3	2.7409	0.9643	2.8424
	1-111	1	2.9337	1.0179	2.8822
		2	3.0265	1.0179	2.9734
		3	2.7409	0.9643	2.8424
	1-11-1	1	2.9337	1.0179	2.8822
		2	2.7592	1.0179	2.7108
		3	2.7409	0.9643	2.8424
	1-1-11	1	3.0600	1.0179	3.0063
		2	3.0265	1.0179	2.9734
		3	2.7409	0.9643	2.8424
	1-1-1-1	1	3.0600	1.0179	3.0063
		2	2.7592	1.0179	2.7108
		3	2.7409	0.9643	2.8424
	-1111	1	2.6520	1.0179	2.6055
		2	4.3393	1.0179	4.2632
		3	2.7409	0.9643	2.8424
	-111-1	1	2.6520	1.0179	2.6055
		2	4.3393	1.0179	4.2632

	3	2.7409	0.9643	2.8424
-11-11	1	2.2224	1.0179	2.1834
	2	4.3393	1.0179	4.2632
	3	2.7409	0.9643	2.8424
-11-1-1	1	2.2224	1.0179	2.1834
	2	4.3393	1.0179	4.2632
	3	2.7409	0.9643	2.8424
-1-111	1	2.4626	1.0179	2.6055
	2	2.8103	1.0179	2.9734
	3	2.5451	0.9643	2.8424
-1-11-1	1	2.6520	1.0179	2.6055
	2	2.7592	1.0179	2.7108
	3	2.5451	0.9643	2.8424
-1-1-11	1	2.2224	1.0179	2.1834
	2	2.8103	1.0179	2.9734
	3	2.5451	0.9643	2.8424
-1-1-1-1	1	2.2224	1.0179	2.1834
	2	2.7592	1.0179	2.7108
	3	2.5451	0.9643	2.8424

(EX1013 at 45-46 (annotated by Patent Owner).) (EX2001, ¶ 144).

Appendix A illustrates that the sequence with the *lowest PAP ratio* is the last sequence in the table (-1, -1, -1, -1),¹ having a PAP ratio of 2.1834, 2.7108, and 2.8424 dB (for 1, 2, and 3 antennas, respectively). On the other hand, the sequence of four additional subcarriers claimed in the '629 patent are (1, 1, -1, -1) (annotated with a green box) has higher values of PAP ratio: 3.0063, 4.2632, and 2.8424 dB. These are not the lowest PAP values in the table, or *even among the five lowest*. (EX2001, ¶ 145).

¹ The “red box” described on p. 29 is reproduced as a black box in this B&W reproduction of the Boer Provisional. However, Patent Owner has annotated with its own red box the sequence and its PAP ratio.

The Boer Provisional explains that the goal of the long training sequence is to “minimize the effect of non-linearity of the [power amplifier] PA and prevent[] clipping in the receiver’s ADs.” (EX1013 at 29.) The Boer patent reiterates this goal. (EX1012 at 5:1-3 (“the extra subcarriers at the edges are modulated in such a way that the peak-to-average power ratio (PAP) is lowest to minimize the effect of non-linearity of the power amplifiers.”).) (EX2001, ¶ 146).

Consequently, even if a POSITA reviewing Boer alone or in combination with any of Jones, Zelst, or 802.11a might have been motivated to “minimize the effect of non-linearity” of the power amplifier, the POSITA would not have considered a sequence that did not have the lowest PAP ratio preferable and would therefore not be motivated to use it. From Boer, a POSITA would have been motivated to use only the sequence (-1, -1, -1, -1) as it has the lowest PAP ratio. Therefore, a POSITA would not only *not* be motivated to use the claimed encoding sequence (shown in the green box), but would be actively steered away from doing so. In other words, Petitioner’s proposed combination using Boer *teaches away* from the claimed 56-subcarrier encoding sequence and this limitation. (EX2001, ¶¶ 147-148). *See, e.g., AstraZeneca AB v. Mylan Pharms. Inc.*, 19 F.4th 1325, 1337 (Fed. Cir. 2021) (“Under this court’s precedent, a prior art reference is said to teach away from the claimed invention if a skilled artisan ‘upon reading the reference, would be discouraged from following the path set out in the reference, **or would be led in a direction divergent from the path that was taken**’ in the claim. And

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Provisional. (EX2001, ¶¶ 149-150). Petitioner and Dr. Buehrer are clearly guided by the disclosure of the '629 patent in conducting their analysis and choosing to select the claimed sequence based entirely on hindsight analysis, which is improper. *InTouch Techs. Inc. v. VGo Comm'ns, Inc.*, 751 F.3d 1327, 1351 (Fed. Cir. 2014). Here, Petitioner uses the claimed sequence as a roadmap to pick one of a possible 16 combinations, while disregarding the actual teachings of Boer which would suggest to **not** pick that combination. EX2001, ¶ 151). *AstraZeneca AB*, 19 F.4th at 1337.

Moreover, because the sequence suggested by the Boer Provisional is not the claimed sequence, it also is not “optimal,” as implicitly acknowledged by Petitioner. (Pet. at 49 (“the patent admits (and requires in the claim) that this is “optimal” and has a minimal PAPR.”).) Therefore, Boer does not teach or suggest the “optimal extended long training sequence” element of the claim, and Petitioner's obviousness theory fails for element 1[f]. (EX2001, ¶ 152).

b) Dependent Claims 4, 8-23, and 27

The Ground 1 references do not render obvious dependent claims 4, 8-23, and 27 of the '629 patent, because at minimum, they each depend from independent claim 1, which is not rendered obvious, for all the reasons set forth above in subsection Section VII.A.a. Because independent claim 1 is not rendered obvious, each dependent claim is likewise not obvious. (EX2001, ¶ 153).

B. Ground 2: Petitioner Has Failed to Show that Claims 1, 4, 8-23,

**and 27 Are Obvious over Jones, 802.11a, 802.11-1999, and Boer
under 35 U.S.C. § 103**

With regard to claims 1, 4, 8-23, and 27, Petitioner has failed to show a reasonable likelihood that Jones, 802.11a, 802.11-1999, and Boer render obvious each and every element of the challenged claims.

a) Claim 1 of the '629 patent:

For example, the following limitations in claim 1 of the '629 patent are not taught by Jones, 802.11a, 802.11-1999, or Boer, alone or in combination.

- i. 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**

Petitioner does not offer any argument or evidence as to claim element 1[c] in Ground 2. Rather, Petitioner simply states that “Ground 2 is duplicative of Ground 1 with one exception—Zelst is not included in Ground 2,” and that “Ground 2 [] relies on all of the arguments and evidence in Ground 1, except the evidence from Zelst.” (Pet. at 73-74.) (EX2001, ¶ 154).

However, there is a fatal flaw with Petitioner's chosen approach. Petitioner's arguments for element 1[c] necessarily rely on evidence from Zelst and the alleged “Zelst 56-subcarrier ELTS.” For example:

The combination discloses “wherein the Inverse Fourier Transformer (IFFT) processes the extended long training sequence (*Zelst 56-subcarrier ELTS*) from the signal generator (Packet Formation block 314), and provides an optimal extended long training sequence with a

minimal peak-to-average ratio (*Zelst 56-subcarrier ELTS processed by the IFFT*).”

...

As explained for limitation 1[b], in the combination, the IFFT *processes Zelst's 56-subcarrier ELTS from the Packet Formation block 314. . . . Zelst's 56-subcarrier ELTS is identical to the disclosed and claimed sequence* and, therefore, the output of the IFFT for each sequence is identical.

...

Zelst's 56-subcarrier ELTS is optimal for the additional reason that the middle 52 subcarriers are identical to the long training sequence in 802.11a. . . . Thus, a device that uses the *Zelst 56-subcarrier ELTS* can coexist with a legacy 802.11a device that uses only the 52 subcarriers from 802.11a.

(Pet. at 48-50.). (EX2001, ¶ 155).

Importantly, nowhere in its analysis for element 1[c] in Ground 1 does Petitioner refer to its purported “*Boer 56-Subcarrier ELTS*”—or any evidence outside of Zelst. Therefore, by admittedly dropping “evidence from Zelst” in Ground 2, Petitioner has waived any argument that the Ground 2 references—which do not include Zelst—teach element 1[c] or render it obvious. Nor does Petitioner attempt to rely on the “Boer 56-Subcarrier ELTS” in its analysis for this element in Ground 2. Instead, at best, Petitioner purports to rely on the purported “Boer 56-Subcarrier ELTS” for elements 1[e]-[f] only:

Jones, 802.11a and 802.11-1999 set the same foundation for Ground 2 as the do for Ground 1, which is incorporated by reference. Specifically, Jones teaches an ELTS could use any of 53-63 subcarriers (including exactly 56 subcarriers) *as required by [1e], and teaches the precise encodings required by [1f]*.

...

In Ground 1, Petitioner relied on Zelst and Boer's teaching that exactly 56 subcarriers should be used *as required by [1e]* and Zelst and Boer's teaching (with Jones) of the precise encodings *required by [1f]*. Petitioner referred to this ELTS as the "Zelst 56-Subcarrier ELTS" to distinguish Grounds 1 and 2. Here, in Ground 2, Petitioner relies on Boer's teachings (in addition to Jones) and so Petitioner refers to the ELTS as the "Boer 56-Subcarrier ELTS" to distinguish from Ground 1.

(Pet. at 74.) (EX2001, ¶¶ 156-157).

Because Petitioner has failed to provide any argument or evidence as to an essential element of claim 1, Ground 2 fails. (EX2001, ¶ 158).

ii. 1[f]: represented by encodings for indexed sub-carriers -28 to +28, excluding indexed sub-carrier 0 which is set to zero, as follows:

<i>Sub-carrier</i>	-28	-27	-26	-25	-24	-23	-22
<i>Encoding</i>	+1	+1	+1	+1	-1	-1	+1
<i>Sub-carrier</i>	-14	-13	-12	-11	-10	-9	-8
<i>Encoding</i>	+1	+1	+1	-1	-1	+1	+1
<i>Sub-carrier</i>	1	2	3	4	5	6	7
<i>Encoding</i>	+1	-1	-1	+1	+1	-1	+1
<i>Sub-carrier</i>	15	16	17	18	19	20	21
<i>Encoding</i>	+1	+1	-1	-1	+1	-1	+1
<i>Sub-carrier</i>	-21	-20	-19	-18	-17	-16	-15
<i>Encoding</i>	+1	-1	+1	-1	+1	+1	+1
<i>Sub-carrier</i>	-7	-6	-5	-4	-3	-2	-1
<i>Encoding</i>	-1	+1	-1	+1	+1	+1	+1
<i>Sub-carrier</i>	8	9	10	11	12	13	14
<i>Encoding</i>	-1	+1	-1	-1	-1	-1	-1
<i>Sub-carrier</i>	22	23	24	25	26	27	28
<i>Encoding</i>	-1	+1	+1	+1	+1	-1	-1.

Even setting aside its failure of evidence as to element 1[c], Petitioner's arguments as to element 1[f] fail under Ground 2. Petitioner states that "[i]t would

have been obvious for a POSITA to use the Boer 56-Subcarrier ELTS in view of the same teachings and opinions explained in Ground 1 . . . In short, Boer's express teaching (including the teachings incorporated from the Boer Provisional) that 56 subcarriers would fit within the 802.11a spectral mask would have rendered obvious to a POSITA to implement Jones's ELTS using exactly 56-subcarriers." (Pet. at 74-75.)

Patent Owner has previously addressed Petitioner's arguments that Boer and the Boer Provisional teach a 56-subcarrier extended long training sequence with the claimed encodings. Specifically, Boer does not teach using 56 active subcarriers. (EX1013 at Fig. 2.) To the extent it is argued it would have been obvious to do so, Boer teaches away from using the claimed subcarrier encodings because it explicitly states that a sequence having the lowest PAP ratio should be used and identifies a different sequence of four additional subcarriers, namely, $(-1 - 1 - 1 - 1)$ as having the lowest PAP ratio. (EX1013 at 29, 45-46.) Patent Owner explicitly incorporates by reference its argument and evidence from subsection VII.A.a.iii.b herein.

Therefore, for the same reasons set forth in Ground 1, the Ground 2 references do not teach or render obvious element 1[f]. (EX2001, ¶¶ 159-160).

b) Dependent Claims 4, 8-23, and 27

The Ground 2 references do not render obvious dependent claims 4, 8-23, and 27 of the '629 patent, because (at a minimum) they each depend from

independent claim 1, which is not rendered obvious, for all the reasons set forth above in subsection Section VII.B.a. Because independent claim 1 is not rendered obvious, each dependent claim is likewise not obvious. (EX2001, ¶ 161).

VIII. CONCLUSION

For the foregoing reasons, the Petition to institute *inter partes* review of any claim of the '629 patent should be denied.

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Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that there are 11,197 words in this paper, excluding any table of contents, table of authorities, mandatory notices under 37 C.F.R. § 42.8, certificate of word count, certificate of service, or appendix of exhibits. This certification relies on the word count of the word-processing system used to prepare this paper.

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