

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEL CORPORATION,
Petitioner,

v.

HERA WIRELESS S.A.,
Patent Owner.

IPR2018-01543
Patent 8,295,400 B2

Before THOMAS L. GIANNETTI, ROBERT L. KINDER, and
JOHN A. HUDALLA, *Administrative Patent Judges*.

HUDALLA, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
Denying Patent Owner's Motion to Amend
35 U.S.C. § 318(a)

Petitioner, Intel Corporation ("Petitioner"), filed a Petition requesting an *inter partes* review of claims 1 and 2 of U.S. Patent No. 8,295,400 B2 (Ex. 1001, "the '400 patent"). Paper 2 ("Pet."). Patent Owner, Hera Wireless S.A. ("Patent Owner"), filed a Preliminary Response. Papers 6, 7 ("Prelim. Resp."). Taking into account the arguments presented in Patent

Owner's Preliminary Response, we determined that the information presented in the Petition established that there was a reasonable likelihood that Petitioner would prevail with respect to its unpatentability challenges. Pursuant to 35 U.S.C. § 314, we instituted this proceeding on March 14, 2019, as to all challenged claims and all grounds of unpatentability. Paper 12 ("Dec. on Inst.").

During the course of trial, Patent Owner did not file a Patent Owner Response. Nonetheless, Patent Owner filed a contingent motion to amend (Paper 26, "Mot. to Amend") proposing to substitute claim 3 and 4 for claims 1 and 2, respectively, if we determined claims 1 and 2 to be unpatentable. Petitioner filed an Opposition to the motion to amend Paper 27 ("Pet. Opp."). In addition, Patent Owner filed a Reply (Paper 29, "PO Reply"), and Petitioner filed a Sur-reply (Paper 30, "Pet. Sur-reply"). An oral hearing was held on December 13, 2019, and a transcript of the hearing is included in the record. Paper 35 ("Tr.").

Petitioner filed Declarations of Stephen B. Wicker, Ph.D., with its Petition (Ex. 1003) and its Opposition to the Motion to Amend (Ex. 1036). Patent Owner did not file any testimonial evidence regarding Petitioner's unpatentability contentions or Patent Owner's motion to amend.

We have jurisdiction under 35 U.S.C. § 6. This decision is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of claims 1 and 2 of the '400 patent. For the reasons discussed below, Petitioner has demonstrated by a preponderance of the evidence that claims 1 and 2 of the '400 patent are unpatentable. We also *deny* Patent Owner's motion to amend.

I. BACKGROUND

A. *Real Parties-in-Interest*

Petitioner identifies Intel Corporation, Lenovo Holding Co., Inc., and Lenovo (United States), Inc., as the real-parties-in-interest. Pet. 2; Paper 10, 1–2; Paper 19, 1. Patent Owner identifies Hera Wireless S.A. and Sisvel UK Limited as the real-parties-in-interest. Paper 5, 2; Paper 10, 2; Paper 22, 2.

B. *Related Proceedings*

The parties identify several district court proceedings concerning the '400 patent: *Hera Wireless S.A. v. Amazon.com, Inc.*, 1:17-cv-00947 (D. Del.); *Hera Wireless S.A. v. ARRIS Group, Inc.*, 1:17-cv-00948 (D. Del.); *Hera Wireless S.A. v. Belkin Int'l, Inc.*, 1:17-cv-00949 (D. Del.); *Hera Wireless S.A. v. Buffalo Americas, Inc.*, 1:17-cv-00950 (D. Del.); *Hera Wireless S.A. v. Netgear, Inc.*, 1:17-cv-00951 (D. Del.); *Hera Wireless S.A. v. Roku, Inc.*, 1:17-cv-00952 (D. Del.); *Hera Wireless S.A. v. Lenovo Holding Co., Inc.*, 1:17-cv-01088 (D. Del.); and *Hera Wireless S.A. v. LG Electronics, Inc.*, 1:17-cv-01089 (D. Del.). Pet. 2–3; Paper 3, 2; Paper 5, 2; Paper 10, 3; Paper 19, 2; Paper 22, 2.

The '400 patent is also the subject of co-pending IPR2018-01739, filed by Ruckus Wireless, Inc., Belkin International, Inc., Amazon.com, Inc.,¹ Netgear, Inc., and Roku, Inc. (“the Ruckus IPR”). Paper 10, 3; Paper 19, 2. A Final Written Decision in the Ruckus IPR is being entered concurrently with this Decision.

¹ A joint motion to terminate IPR2018-01739 as to Amazon.com, Inc. has been granted. IPR2018-01739, Paper 13.

Furthermore, Petitioner and others have filed petitions seeking *inter partes* review of several patents held by Patent Owner, including: IPR2018-01371 (challenging U.S. Patent No. 7,962,103); IPR2018-01372 (challenging U.S. Patent No. 8,412,115); IPR2018-01373 (challenging U.S. Patent No. 8,934,851); IPR2018-01418 (challenging U.S. Patent No. 7,962,103); IPR2018-01419 (challenging U.S. Patent No. 8,415,115); IPR2018-01420 (challenging U.S. Patent No. 8,934,851); IPR2018-01421 (challenging U.S. Patent No. 8,934,851); IPR2018-01657 (challenging U.S. Patent No. 9,270,024); IPR2018-01686 (challenging U.S. Patent No. 8,737,377); IPR2018-01687 (challenging U.S. Patent No. 8,737,377); IPR2018-01700 (challenging U.S. Patent No. 7,369,878); IPR2018-01701 (challenging U.S. Patent No. 7,454,234); IPR2018-01702 (challenging U.S. Patent No. 7,873,389); and IPR2018-01732 (challenging U.S. Patent No. 9,270,024).

C. The '400 patent

The '400 patent is titled “Receiving Method and Apparatus, and Communication System Using the Same.” Ex. 1001, code (54). The patent relates to a method and apparatus for improving the efficiency of a “mixed-mode” wireless communication system that includes Multiple-Input Multiple-Output (“MIMO”) and legacy 802.11a (“target”) radio devices. *Id.* at 1:58–2:22. The '400 patent recognizes the existence of prior art mixed-mode Orthogonal Frequency Division Multiplexing (“OFDM”) communication systems capable of supporting MIMO and target devices operating on the same frequency band. *Id.* at 1:13–2:6. The patent explains, however, that “when the traffic of burst signals in the MIMO system

becomes heavy, the power consumed by the [non-MIMO, target] receiving apparatus increases even though the receiving apparatus does not demodulate the effective burst signals.” *Id.* at 2:8–12. To address this shortcoming of the prior art, the ’400 patent describes a method and apparatus for reducing the power consumption of a target radio device that receives a MIMO signal. *Id.* at 2:16–22.

The ’400 patent discloses combining a legacy 802.11a target burst format, including a preamble, control signal, and data, with MIMO-specific signals in order to create a MIMO burst format. Ex. 1001, 9:37–47. Specifically, the patent teaches that “the packet signal in a MIMO system is such that a preamble of the target system, a control signal of the target system, a control signal of the MIMO system, a preamble of the MIMO system and data of the MIMO system are assigned in this order.” *Id.* at 9:37–43. The patent further explains that a target radio device determines whether a received burst signal is a target signal or a MIMO signal, and stops processing if a MIMO control signal is received. *Id.* at 9:55–67, 13:66–14:4.

Figures 4A and 4B depicting the burst formats disclosed in the ’400 patent are reproduced below.

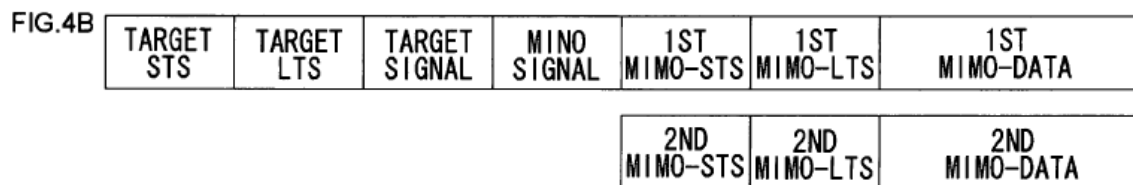


Figure 4A depicts the burst format for a target system corresponding to the traffic channel of 802.11a (Ex. 1001, 11:47–49), and Figure 4B shows the burst format of a MIMO system having two transmit antennas in accord with the claimed invention (*id.* at 12:12–16). The “Target STS” and “Target LTS” signals included in each of Figures 4A and 4B are short and long training signals that correspond to the preamble of the target system. *Id.* at 11:49–56, 12:6–9. The “Target signal” present in each Figure constitutes the control signal for the target system. *Id.* The “Target data” is the message portion of an 802.11a burst signal. *Id.* at 11:56–57. Figure 4B additionally includes a MIMO control signal, designated “MIMO signal,” as well as two MIMO preambles, each incorporating a short and long training signal: 1st MIMO-STS and 1st MIMO-LTS for transmission over the first antenna, and 2nd MIMO-STS and 2nd MIMO-LTS, for transmission over the second antenna. *Id.* at 12:12–35.

The ’400 patent describes various ways in which a target radio device can determine whether a burst signal is in legacy 802.11a or MIMO format. The embodiments most relevant to the challenged claims rely on subcarriers reserved for pilot signals. In this regard, the ’400 patent discloses using known pilot signals assigned to predetermined subcarriers in an OFDM system so that the same pilot signal carrying subcarriers are used in target and MIMO systems. Ex. 1001, 20:14–19, 20:21–27. The patent exemplifies embodiments in which both the target and MIMO systems use the same OFDM subcarriers for pilot signals as 802.11a: -21, -7, 7, and 21. *Id.* at 20:49–57. The ’400 patent also discloses using the same modulation scheme for the pilot signals in both target and MIMO systems. *Id.* at 20:58–62. The ’400 patent teaches, however, that target and MIMO pilot signals have

different patterns in order to allow target radio devices to identify whether a signal is a target or MIMO signal. For example, the '400 patent describes an embodiment in which the target signal uses the same pilot pattern as 802.11a, but for the MIMO signal, the pilots are inverted. *Id.* at 21:4–14.

The '400 patent also teaches that the multiple antennas of a MIMO transmitter may transmit the same information in the same order (i.e., the same burst signal) but with individual signals shifted cyclically left or right, using a technique known as cyclic delay diversity (“CDD”). Ex. 1001, 17:11–55.

The '400 patent claims priority to two Japanese patent applications dating to as early as September 10, 2004. *Id.*, code (30). The U.S. application that led to the '400 patent was filed on September 9, 2005. *Id.*, code (22). As discussed below, Petitioner establishes that, at a minimum, its asserted references qualify as prior art relative to either (1) the September 9, 2005, filing date of the U.S. application; or (2) the September 10, 2004, date of the earlier Japanese patent application (i.e., the earliest possible effective filing date). *Id.*, codes (22), (30).

D. Illustrative Claim

The '400 patent includes two claims, each of which is independent. Claim 2, reproduced below, is illustrative of the claimed subject matter.

2. A transmitting method for transmitting an OFDM signal, comprising:

generating a burst signal having a first burst format where a first Non-MIMO training signal, a first Non-MIMO

signal, a MIMO signal, a MIMO training signal, and first data are arranged in the stated order; and

transmitting the burst signal, wherein

a subcarrier carrying a first pilot signal included by frequency-division multiplexing in the first data in the first burst format is the same as a subcarrier carrying a second pilot signal included by frequency-division multiplexing in second data in a second format where a second Non-MIMO training signal, a second Non-MIMO signal, and the second data are arranged in the stated order,

a modulation scheme of the first pilot signal is the same as a modulation scheme of the second pilot signal,

a pattern of the first pilot signal is different from a pattern of the second pilot signal, and

the transmitting transmits the burst signal from a plurality of antennas such that the signal transmitted from a given one antenna is shifted in timing with respect to the signal transmitted from another antenna in a cyclical manner.

Ex. 1001, 26:22–42. Claim 1 recites an apparatus for performing the method of claim 2. *Id.* at 25:40–26:21.

E. Prior Art

Petitioner relies on the following prior art:

IEEE 802.11-04/889r0, *TGn Sync Proposal Technical Specification* (Aug. 13, 2004) (Ex. 1003, “TGn-Sync”);

IEEE Std 802.11a-1999 (R2003) (Supplement to IEEE Std 802.11-1999) *Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications: High-speed Physical Layer in the 5 GHz Band* (June 12, 2003) (Ex. 1004, “802.11a”);

U.S. Patent No. 7,616,698 B2, filed Nov. 3, 2004, issued Nov. 10, 2009 (Ex. 1005, “Sun”); and

U.S. Patent No. 6,842,487 B1, filed Sept. 22, 2000, issued Jan. 11, 2005 (Ex. 1006, “Larsson”).

F. The Instituted Grounds

We instituted *inter partes* review of claims 1 and 2 of the ’400 patent on the following grounds (Dec. on Inst. 47), which are all the grounds presented in the Petition (Pet. 4):

Claims Challenged	35 U.S.C. §	References
1, 2	103(a) ²	TGn-Sync, 802.11a
1, 2	103(a)	Sun, 802.11a, Larsson

II. ANALYSIS

A. Legal Standards

A claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *See KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007).

The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) where in evidence, so-called secondary

² The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. § 103. Because the effective filing date of the ’783 patent is before March 16, 2013 (the effective date of the relevant amendment), the pre-AIA version of § 103 applies.

considerations.³ *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). We also recognize that prior art references must be “considered together with the knowledge of one of ordinary skill in the pertinent art.” *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994) (quoting *In re Samour*, 571 F.2d 559, 562 (CCPA 1978)). We analyze Petitioner’s obviousness contentions with the principles identified above in mind.

B. Level of Ordinary Skill in the Art

In the Decision on Institution, we determined that a person of ordinary skill in the art would have had a Master’s degree in Electrical Engineering, at least 2–4 years of academic or industry experience designing and implementing digital wireless communication systems, and familiarity with the family of IEEE 802.11 standards. Dec. on Inst. 13–14 (citing Ex. 1002 ¶ 53). Neither party disputes our determination. We discern no reason to change our determination and apply it for purposes of this Decision.

C. Claim Interpretation

Because this *inter partes* review is based on a petition filed before November 13, 2018,⁴ we construe the claims by applying the broadest

³ The record does not contain any evidence of secondary considerations of nonobviousness.

⁴ On October 11, 2018, the USPTO revised its rules to harmonize the Board’s claim construction standard with that used in federal district court. Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board, 83 Fed. Reg. 51,340 (Oct. 11, 2018) (codified at 37 C.F.R. 42.100(b) (2019)). This rule change applies only to petitions filed after November 13, 2018, however. Thus, the revised claim construction standard does not apply to this proceeding. *Id.*

reasonable interpretation in light of the specification. 37 C.F.R. § 42.100(b) (2018); *see Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). Under the broadest reasonable interpretation standard, and absent any special definitions, claim terms are given their ordinary and customary meaning, as would have been understood by one of ordinary skill in the art in the context of the entire disclosure. *See In re Translogic Tech. Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Any special definitions for claim terms or phrases must be set forth “with reasonable clarity, deliberateness, and precision.” *Paulsen*, 30 F.3d at 1480.

In our Decision on Institution, we interpreted the limitation “a subcarrier carrying a first pilot signal . . . is the same as a subcarrier carrying a second pilot signal” in claims 1 and 2. Dec. on Inst. 15–18. We noted that “a subcarrier carrying a first pilot signal” pertains to a MIMO transmission, whereas “a subcarrier carrying a second pilot signal” refers to a target (non-MIMO) transmission. *Id.* at 15–16 (citing Ex. 1001, 25:43–13, 26:23–35). Regarding the recited sameness of these subcarriers, we determined that the limitation “require[s] that at least one subcarrier . . . carrying a pilot signal in a MIMO system is the same as at least one subcarrier carrying a pilot signal in a target system.” *Id.* at 18. The parties do not dispute this determination, and we discern no reason to change it. Accordingly, we adopt our interpretation and analysis for this limitation from the Decision on Institution.

At institution, we also interpreted the limitation “a modulation scheme of the first pilot signal is the same as a modulation scheme of the second pilot signal” in claims 1 and 2. Dec. on Inst. 18–20. We declined to read into this limitation a requirement that the modulation scheme used for the

MIMO and target pilot signals must yield the same signal point constellation for those pilot signals. *Id.* at 19. Accordingly, we interpreted this limitation

to require that a modulation scheme applied to the at least one pilot signal in a MIMO system that is carried on the same subcarrier as the at least one pilot signal in a target system is the same as a modulation scheme applied to that at least one pilot signal in the target system.

Id. Again, the parties do not dispute this determination, and we discern no reason to change it. Accordingly, we adopt our interpretation and analysis for this limitation from the Decision on Institution.

We determine that no other terms require explicit construction. *See, e.g., Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (“[W]e need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

D. Obviousness Ground Based on TGn-Sync and 802.11a

Petitioner contends the subject matter of claims 1 and 2 would have been obvious over the combination of TGn-Sync and 802.11a. Pet. 37–59.

1. 802.11a

802.11a is a supplement to the IEEE 802.11, i.e., “Wi-Fi,” standard that modified the standard to incorporate OFDM and improve throughput. Ex. 1004, i, 3. 802.11a discloses that “[t]he system uses 52 subcarriers that are modulated using binary or quadrature phase shift keying (BPSK/QPSK), 16-quadrature amplitude modulation (QAM), or 64-QAM.” *Id.* at 3. 802.11a further explains:

In each OFDM symbol, four of the subcarriers are dedicated to pilot signals in order to make the coherent detection robust against frequency offsets and phase noise. These pilot signals shall be put in subcarriers -21, -7, 7 and 21. The pilots shall be BPSK modulated by a pseudo binary sequence to prevent the generation of spectral lines. The contribution of the pilot subcarriers to each OFDM symbol is described in 17.3.5.9.

Id. at 22. More particularly, 802.11a explains that the pattern of values for the four pilot signals is 1, 1, 1, -1 (*id.* at 22 (equation 24)), and that the sequence of pilot signals is multiplied by a pseudorandom sequence defined in equation 25 of 802.11a to control polarity, and subsequently transmitted using BPSK modulation (*id.* at 22–23).

The data frame, i.e., Physical Layer Convergence Procedure protocol data units (PPDU), format defined by 802.11a is depicted in Figure 107, which is reproduced below.

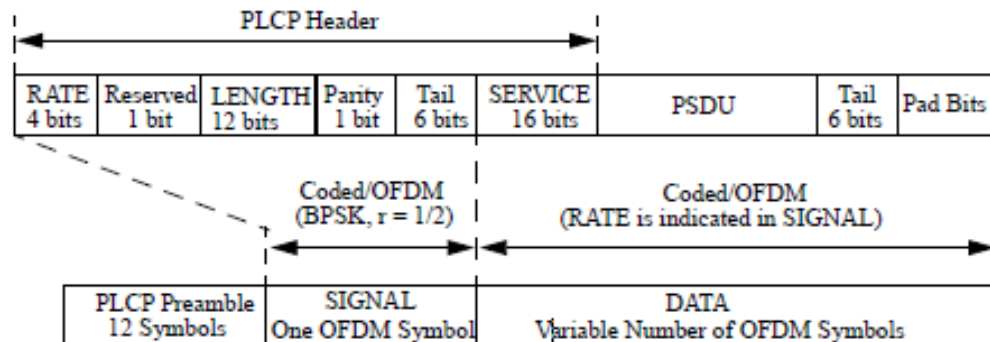


Figure 107—PPDU frame format

As illustrated in Figure 107 of 802.11a above, the PPDU frame includes a Physical Layer Convergence Protocol (PLCP) preamble, which is “composed of 10 repetitions of a ‘short training sequence’ (used for AGC convergence, diversity selection, timing acquisition, and coarse frequency acquisition in the receiver) and two repetitions of a ‘long training sequence’

(used for channel estimation and fine frequency acquisition in the receiver), preceded by a guard interval (GI).” Ex. 1004, 7. Subsequent to the PLCP preamble, the PPDU frame includes a BSPK encoded SIGNAL field that incorporates RATE and LENGTH fields. *Id.* at 8. A DATA field follows the SIGNAL field. *Id.*

802.11a also discloses a transmitter and receiver for the OFDM physical layer. Figure 118 of 802.11a is reproduced below.

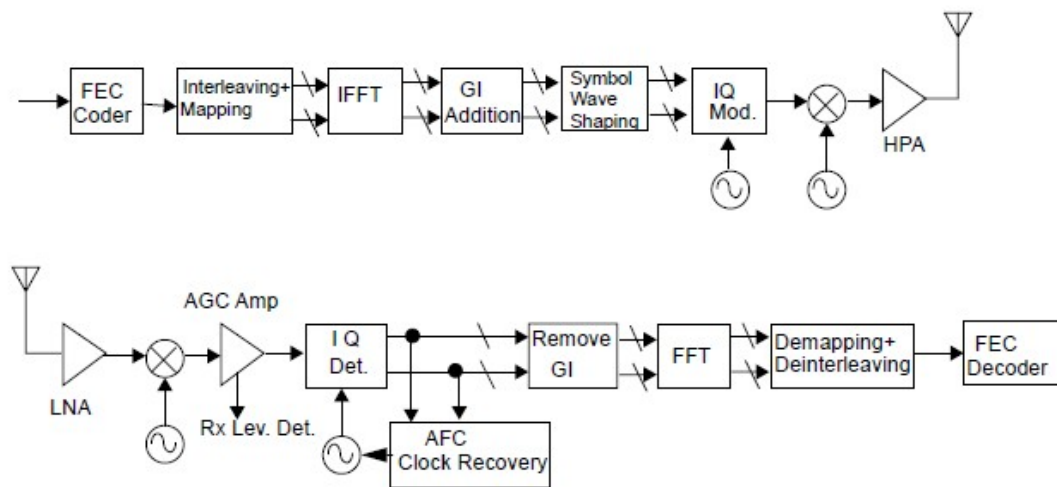


Figure 118—Transmitter and receiver block diagram for the OFDM PHY

Figure 118 shows block diagrams for a transmitter (top) and receiver (bottom) for the OFDM physical layer. Ex. 1004, 24. 802.11a additionally describes the process for generating a burst signal, including steps for encoding, interleaving, mapping, Fourier transformation, guard interval addition, quadrature modulation, preamble generation, and combination with the remainder of a burst signal. *Id.* at 7–8, 54–83.

Petitioner contends 802.11a qualifies as prior art under, *inter alia*, 35 U.S.C. § 102(b) based on its publication date of December 1999. Pet. 16 (citing Ex. 1002 ¶ 161; Ex. 1004, i, 3; Ex. 1009 ¶ 27; Ex. 1032 ¶¶ 8–11). In

support of its contention, Petitioner cites testimony from Gerard P. Grenier, a Senior Director of Publishing Technologies with IEEE. Ex. 1032 ¶ 1. Mr. Grenier testifies that 802.11a was initially published on December 30, 1999, and then republished on June 12, 2003. *Id.* ¶ 11.

We are persuaded that 802.11a qualifies as prior art under § 102(b) based on Mr. Grenier's un rebutted testimony. 802.11a's initial publication date of December 30, 1999, is more than one year before the U.S. filing date of the application that led to the '400 patent, which is September 9, 2005. Ex. 1001, code (22); Ex. 1032 ¶ 11.

2. *TGn-Sync*

TGn-Sync is a proposed MIMO extension to the 802.11 standard that was submitted to the 802.11 Task Group n ("TGn") during development of the 802.11n standard. Ex. 1003, 1, 3. TGn-Sync explains that "[t]he PHY techniques used to achieve the higher data rates involve a MIMO evolution of 802.11 OFDM PHY with spatial division multiplexing of spatial streams, and wider bandwidth options." *Id.* at 3. According to TGn-Sync, the "proposal also offers seamless interoperability with 802.11 legacy devices. This interoperability is achieved with an enhanced 802.11 preamble design and efficient PHY and MAC level mechanisms, which also provide robustness and cost-effectiveness." *Id.* In particular, TGn-Sync discloses "full backwards compatibility with existing 802.11a/b/g standards. Our preamble design support[s] PHY layer interoperability with the OFDM preamble from 802.11a/g, while providing a robust mechanism for synchronization of the high throughput data." *Id.* at 17.

TGn-Sync discloses both a legacy 20 MHz PPDU format and a high throughput (“HT”), i.e., MIMO, 20 MHz PPDU format that is interoperable with 802.11a. Ex. 1003, 94. Figure 40 of TGn-Sync is reproduced below.

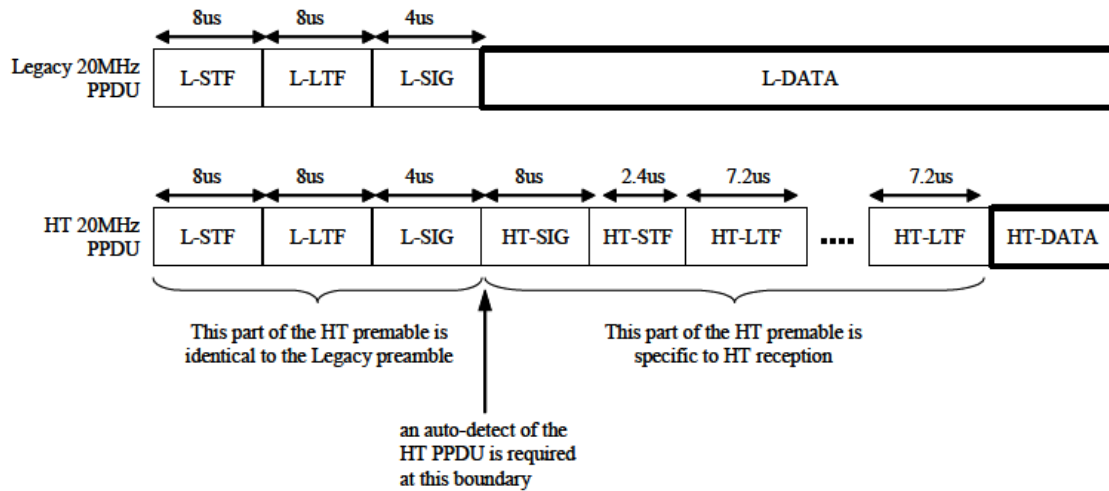


Figure 40 depicts a legacy preamble and an HT-specific preamble. *Id.* Figure 40 shows that the 802.11a legacy non-MIMO burst format includes, in order: a legacy training signal (including “L-STF” and “L-LTF”), a legacy control signal (“L-SIG”) and legacy data (“L-DATA”). Ex. 1003, 94. Figure 40 also discloses that TGn-Sync’s HT burst format, includes, in order: a legacy training signal, a legacy control signal, a MIMO control signal (“HT-SIG”), a HT training signal (including “HT-STF” and “HT-LTF”) and HT data (“HT-DATA”). *Id.* at 94, 102, 110, 111–16, Figs. 30, 37, 40.

TGn-Sync also teaches the use of cyclical delay diversity (“CDD”) to mitigate beamforming when transmitting the same signal from multiple antennas. Ex. 1003, 101. A PPDU format leveraging CDD transmission is depicted in Figure 46 of TGn-Sync, which is reproduced below.

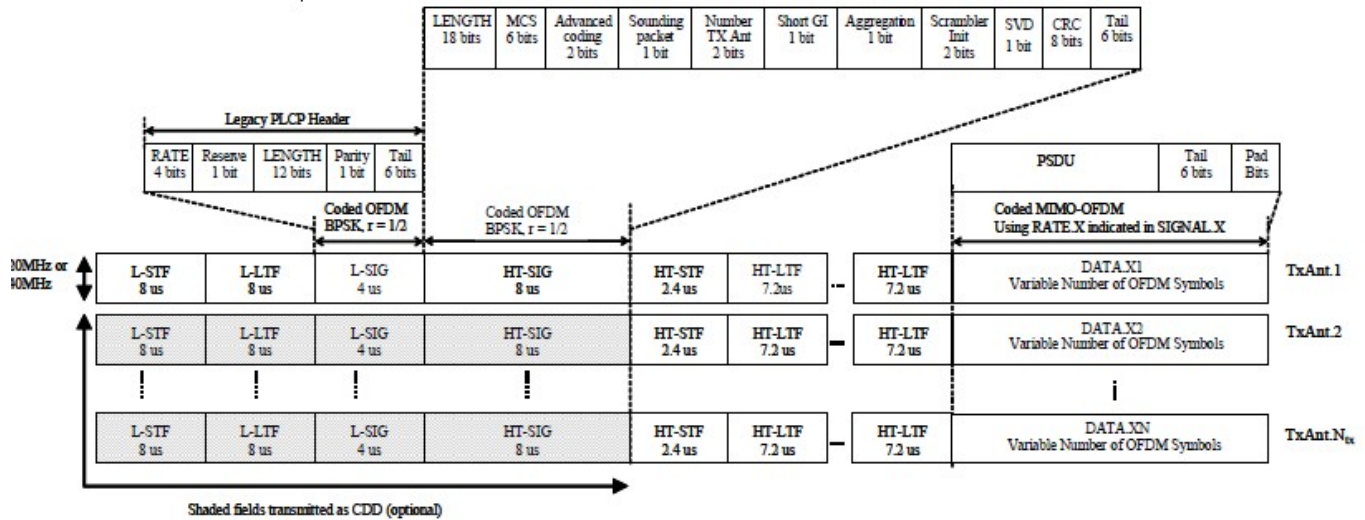


Figure 46 depicts a PPDU format leveraging CDD transmission. *Id.* As illustrated in Figure 46, the shaded fields may be transmitted as CCD. *Id.* TGN-Sync explains that the legacy short and long training fields were “identical” to the respective training fields in 802.11a. *Id.* at 102, 103. With regard to the legacy control signal, TGN-Sync discloses that it has the same format as the 802.11a SIGNAL field, except that the RATE and LENGTH fields are “spoofed” to prevent legacy stations from accessing the medium during HT frame transmission. *Id.* at 110–11.

TGN-Sync discloses transmitting pilot tones using the same subcarriers as 802.11a: -21, -7, 7, and 21 for transmissions in the 20 MHz bandwidth. Ex. 1003, 122–23. TGN-Sync also teaches that in legacy mode, pilot signals are defined in 802.11a. *Id.* at 123. In HT-mode, TGN-Sync discloses that pilot signals are defined by multiplying the sequence in equation 25 of 802.11a by an additional sequence described in equations 47 and 48 of TGN-Sync. *Id.*

TGN-Sync additionally provides a transmitter block diagram for two-antenna MIMO in 20 MHz, shown in Figure 35, which is reproduced below.

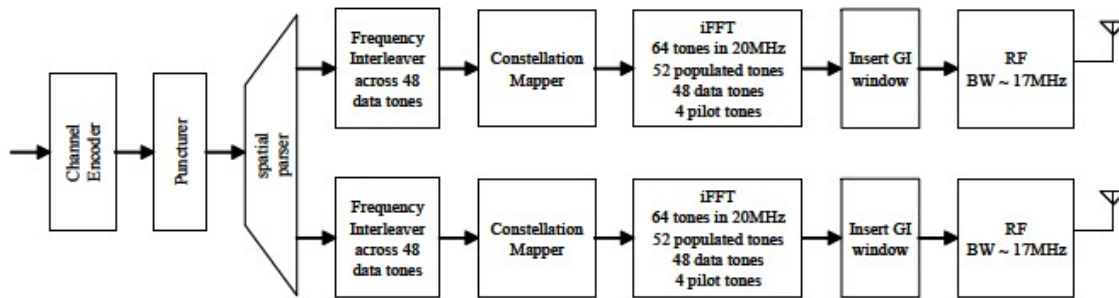


Figure 35: Transmitter Datapath for 2-antenna MIMO in 20MHz

Figure 35 illustrates “[t]he basic mandatory configuration in [the TGn-Sync] PHY proposal for throughput enhancement.” Ex. 1003, 92.

Petitioner contends TGn-Sync qualifies as prior art under, *inter alia*, 35 U.S.C. § 102(b) based on its publication date of August 14, 2004. Pet. 20 (citing Ex. 1009 ¶¶ 13–18). In support of its contention, Petitioner cites testimony from Adrian Stephens, an engineer who previously worked at Intel Corporation (UK) Ltd. Ex. 1009 ¶ 4. Mr. Stephens testifies that TGn-Sync was published via a publicly accessible website on August 14, 2004. *Id.* ¶¶ 13–14, 18.

We are persuaded that TGn-Sync qualifies as prior art under § 102(b) based on Mr. Stephens’s un rebutted testimony. TGn-Sync’s publication date of August 14, 2004, is more than one year before the U.S. filing date of the application that led to the ’400 patent, which is September 9, 2005. Ex. 1001, code (22); Ex. 1009 ¶ 18.

3. Claim 1

We now consider whether Petitioner has met its burden of proving unpatentability by a preponderance of the evidence under 35 U.S.C. § 316(e).

The preamble of claim 1 recites “[a] transmitting apparatus for transmitting an OFDM signal.” Ex. 1001, 25:41–42. Petitioner cites TGn-Sync’s disclosure of “transmitters that sent OFDM signals.” Pet. 39 (citing Ex. 1003, 3, 90, 92, 95–96). Figure 35 of TGn-Sync, as annotated by Petitioner, is reproduced below.

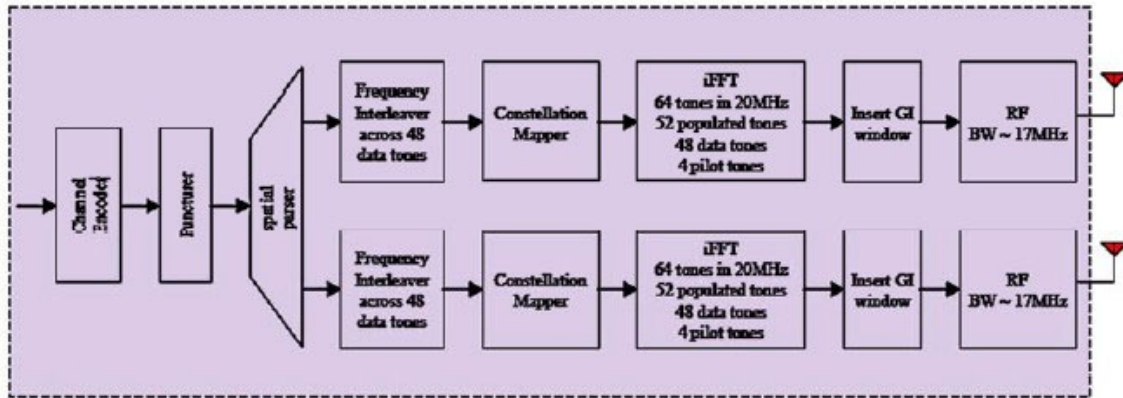


Figure 35: Transmitter Datapath for 2-antenna MIMO in 20MHz

Pet. 39. Annotated Figure 35 of TGn-Sync is a block diagram depicting the transmitter datapath for two-antenna MIMO in 20 MHz. Ex. 1003, 92. According to Petitioner, the portions of Annotated Figure 35 highlighted in purple correspond to an exemplary OFDM-capable transmitter disclosed by TGn-Sync. Pet. 39. Thus, even if the preamble were considered limiting, the combination of TGn-Sync and 802.11a teaches the preamble of claim 1.

Claim 1 further recites “a generator operative to generate a burst signal having a first burst format where a first Non-MIMO training signal, a first Non-MIMO signal, a MIMO signal, a MIMO training signal, and first data are arranged in the stated order.” Ex. 1001, 25:43–26:3. Turning first to the recitation in this claim element of a “generator operative to generate a burst signal having a first burst format” (Ex. 1001, 25:43–44), Petitioner asserts that the transmitter datapath for creating burst signals disclosed by TGn-Sync satisfies this claim requirement. Pet. 43–48 (citing, *inter alia*,

Ex. 1003, 15, 42, 90–92, 95–97, 117, Figs. 35, 36, 41, 43). For example, Petitioner points to the two-datapath transmitter of Figure 35 of TGn-Sync as disclosing this claim element. Figure 35 of TGn-Sync, as further annotated by Petitioner, is reproduced below.

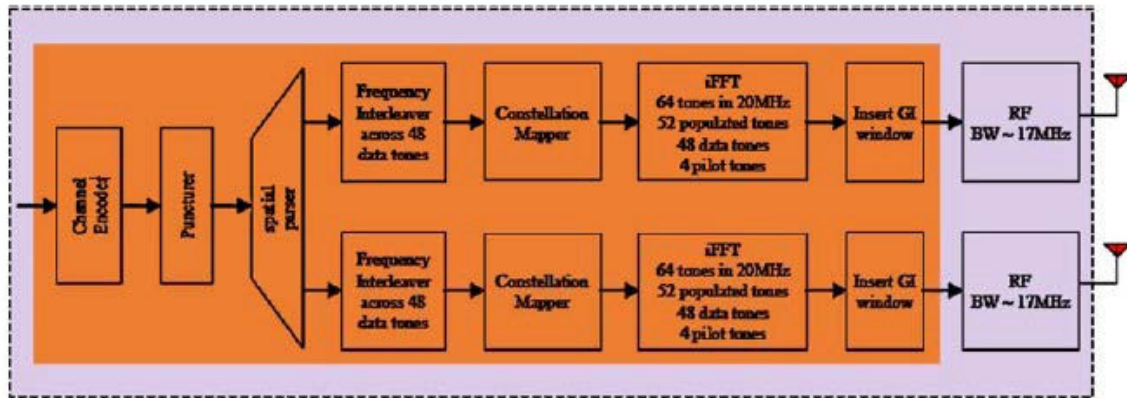


Figure 35: Transmitter Datapath for 2-antenna MIMO in 20MHz

Pet. 44. According to Petitioner, this annotated version of Figure 35 shows certain functional blocks of the transmitter (highlighted in orange) that work together to generate a MIMO burst, which satisfies the ordinary meaning of a “generator.” Pet. 43 (citing Ex. 1002 ¶ 242).

As to the claimed first burst format, and its recited subcomponents, Petitioner contends that TGn-Sync discloses these limitations in Figure 40. Pet. 40. To explain its contention, Petitioner provides an annotated and excerpted version of Figure 40, which is reproduced below.

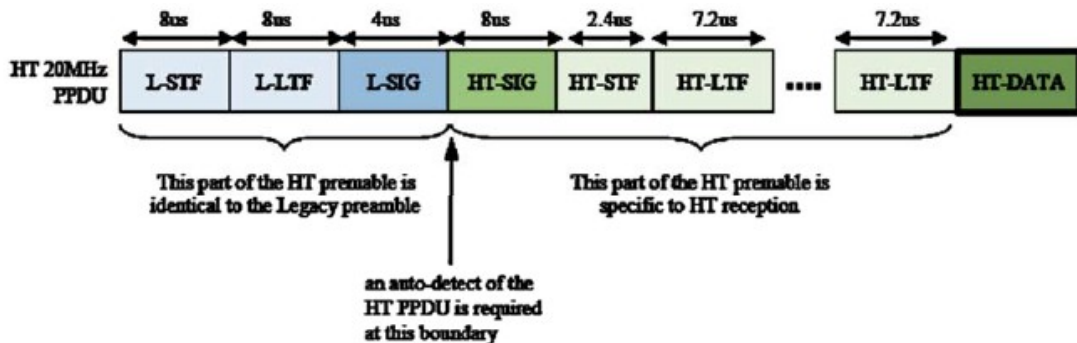


Figure 40: HT Preamble format

Pet. 40. According to Petitioner, this annotated version of TGn-Sync's Figure 40 depicts a frame format including, in order, non-MIMO training signals L-STF and L-LTF (Ex. 1003, 102–104), non-MIMO control signal L-SIG (*id.* at 101, 110–12), MIMO control signal HT-SIG (*id.* at 95, 112–16), MIMO training signals HT-STF and HT-LTF (*id.* at 95, 104, 105, 109), and MIMO data HT-DATA (*id.* at 116). Pet. 40.

We are persuaded by Petitioner's analysis, and we find that the combination of TGn-Sync and 802.11a teaches the “generator” limitation of claim 1.

Claim 1 further recites “a transmitter operative to transmit the burst signal generated by the generator.” Ex. 1001, 26:4–5. Petitioner cites TGn-Sync's teachings of “a transmitter that sent the MIMO burst generated by the generator.” Pet. 48–49 (citing Ex. 1003, 15, 42, 90–92, 95–97, 117, Figs. 35, 36, 41, 43). For example, Petitioner cites the components of the transmitter datapath highlighted in purple in the first annotated version of TGn-Sync's Figure 35, which is reproduced above in our discussion of the claim 1 preamble. *Id.* at 49 (citing Ex. 1003, 117, Fig. 35). Thus, we find that the combination of TGn-Sync and 802.11a teaches the “transmitter” limitation of claim 1.

Claim 1 further recites:

a subcarrier carrying a first pilot signal included by frequency-division multiplexing in the first data in the first burst format of the burst signal generated by the generator is the same as a subcarrier carrying a second pilot signal included by frequency-division multiplexing in second data in a second format where a second Non-MIMO training signal, a second Non-MIMO signal, and the second data are arranged in the stated order.

Ex. 1001, 26:6–13. As set forth above, we construe this claim limitation as requiring that at least one subcarrier carrier carrying a pilot signal in a MIMO system is the same as at least one subcarrier carrying a pilot signal in a target system. *See supra* § II.C. Petitioner asserts that TGn-Sync, either alone or in combination with 802.11a, teaches this claim element.

Concerning the “second data in a second format where a second Non-MIMO training signal, a second Non-MIMO signal, and the second data are arranged in the stated order” (Ex. 1001, 26:11–13), Petitioner asserts that each of TGn-Sync and 802.11a discloses the same non-MIMO, legacy frame format, including, in order, non-MIMO training signals, a non-MIMO control signal, and non-MIMO data. Pet. 50 (citing Ex. 1003, 101–03; Ex. 1004, 7). For the requirement that “a subcarrier carrying a first pilot signal . . . is the same as a subcarrier carrying a second pilot signal” (Ex. 1001, 26:6–10), Petitioner states that “[i]n its 20Mhz MIMO mode, TGn-Sync taught using OFDM to add pilot tones to four subcarriers in data symbols: subcarriers -21, -7, 7 and 21. Pet. 51 (citing Ex. 1003, 120, 122). Petitioner further explains that TGn-Sync and 802.11a each disclose using the same four pilot subcarriers for non-MIMO, legacy transmissions. *Id.* (citing Ex. 1002 ¶ 271; Ex. 1004, 22).

We are persuaded by Petitioner’s analysis, and we find that the combination of TGn-Sync and 802.11a teaches the “subcarrier” limitation of claim 1.

Claim 1 further recites “a modulation scheme of the first pilot signal is the same as a modulation scheme of the second pilot signal.” Ex. 1001, 26:14–15. Petitioner contends the combination of TGn-Sync and 802.11a teaches or suggests this limitation. Pet. 54–56. Petitioner identifies three

ways in which the proposed combination purportedly teaches this claim element. First, Petitioner contends that use of OFDM by TGn-Sync for MIMO and non-MIMO transmissions, and by 802.11a for non-MIMO transmissions, satisfies this claim element. Pet. 54 (citing Ex. 1003, 120, 122; Ex. 1004, 7–8, 22). Second, Petitioner contends that “both 802.11a and TGn-Sync disclosed using BPSK modulation on pilot signals.” *Id.* In support of this contention, Petitioner asserts that “802.11a taught that the initially-assigned non-MIMO pilot signals in data symbols were ‘BPSK modulated by a pseudo binary sequence [polarity sequence] to prevent the generation of spectral lines.’ [Ex. 1004], 22. TGn-Sync used the same polarity sequence (p_n) to BPSK modulate the initially-assigned pilot signals.” Pet. 54–55 (citing Ex. 1002 ¶ 282; Ex. 1003, 123; Ex. 1004, 22–23). Third, Petitioner argues that “a skilled person would have used BPSK modulation in initially assigning TGn-Sync and 802.11a’s non-MIMO and MIMO pilot signals.” *Id.* at 55. Specifically, Petitioner contends that such a skilled artisan would have used “BPSK modulation for TGn-Sync’s MIMO pilot signals when those signals were limited to I values of 1 and -1,” as is the case for antennas 1 and 3 in a system with three transmitting antennas. *Id.* (citing Ex. 1002 ¶¶ 284–288; Ex. 1004, 19–23).

We are persuaded by Petitioner’s analysis, and we find that the combination of TGn-Sync and 802.11a teaches the “modulation scheme” limitation of claim 1.

Claim 1 further recites “a pattern of the first pilot signal is different from a pattern of the second pilot signal.” Ex. 1001, 26:16–17. Petitioner again relies on the combination of TGn-Sync and 802.11a for teaching this limitation. Pet. 52–54. According to Petitioner, TGn-Sync and 802.11a

teach the use of different initially-assigned pilot signal patterns for MIMO and non-MIMO packets. *Id.* at 52. Petitioner asserts that the pilot signal pattern assigned to subcarriers -21, -7, 7, and 21 for legacy burst data in 802.11a is 1, 1, 1, -1. *Id.* (citing Ex. 1002 ¶ 276; Ex. 1004, 22). Relying on the testimony of Dr. Wicker, Petitioner further asserts that, for a three-antenna system, TGn-Sync discloses initially-assigned MIMO pilot signal patterns for the second and third antennas—1, j, -1, j and 1, -1, 1, 1, respectively—that differ from the non-MIMO legacy pattern of 802.11a. *Id.* at 52–53 (citing Ex. 1002 ¶¶ 277–278). Petitioner also contends that “while TGn-Sync and IEEE 802.11a used the same pilot polarity sequence (Ex. 1003, 123:15–16; Ex. 1004, 23 (equation (25))), where the initially-assigned pilot patterns were different (e.g., for the second and third antennas), the pilot signal patterns after polarity sequence multiplication were also different.” Pet. 53–54 (citing Ex. 1002 ¶ 279).

We are persuaded by Petitioner’s analysis, and we find that the combination of TGn-Sync and 802.11a teaches the “pattern” limitation of claim 1.

The final limitation in claim 1 recites “the transmitter transmits the burst signal from a plurality of antennas such that the signal transmitted from a given one antenna is shifted in timing with respect to the signal transmitted from another antenna in a cyclical manner.” Ex. 1001, 26:18–21. Petitioner contends that, “[t]o avoid unwanted beamforming, TGn-Sync taught transmitting some burst fields using the known CDD technique.” Pet. 56 (citing Ex. 1003, 93–94). Petitioner further explains that “TGn-Sync recommended using CDD anytime more than one antenna was used for transmission of the same data.” *Id.* at 57 (citing Ex. 1003, 95). In support of

its position, Petitioner provides an annotated version of Figure 37 of TGn-Sync, which is reproduced below.

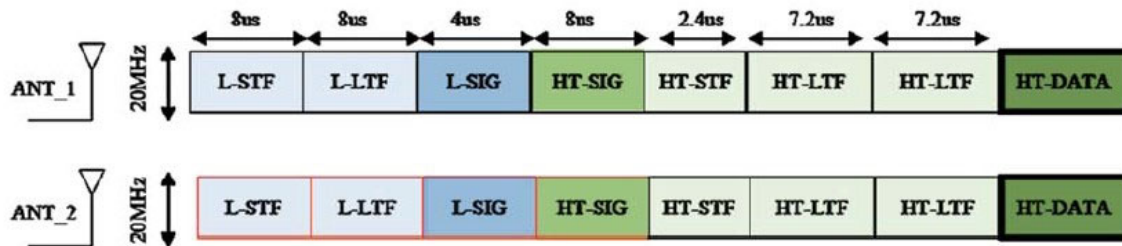


Figure 37: PPDU Format for 2x20 Mandatory Basic MIMO Transmission

Pet. 57. According to Petitioner, annotated Figure 37 “shows antenna 2 (ANT_2) transmitting the L-STF, L-LTF, L-SIG and HT-SIG fields (outlined in red) shifted in timing with respect to the same signals transmitted by antenna 1 (ANT_1).” *Id.* at 56–57 (citing Ex. 1003, 93).

We are persuaded by Petitioner’s analysis, and we find that the combination of TGn-Sync and 802.11a teaches the final limitation of claim 1.

Petitioner contends that an ordinarily skilled artisan would have sought to combine TGn-Sync and 802.11a because “TGn-Sync was built upon and ensured compatibility with 802.11a.” Pet. 24 (citing Ex. 1003, 3, 16, 17). In this regard, Petitioner points out that “TGn-Sync referred expressly to 802.11a for a description of the data pilot signal pattern of a non-MIMO burst and the use of BPSK on those legacy pilot signals,” and “taught that the legacy non-MIMO 802.11a training and control signals should be included as the first two pieces in a burst signal format and that a MIMO (HT) control signal and MIMO data should follow (in that order).” *Id.* Thus, citing testimony from Dr. Wicker, Petitioner contends “[i]t would have been obvious for a skilled person to do as TGn-Sync recommends and combine those teachings from 802.11a with the augmented teachings of

TGn-Sync.” *Id.* (citing Ex. 1002 ¶¶ 212–216). Given TGn-Sync’s express reliance on earlier 802.11 standards (*see, e.g.*, Ex. 1003, 3, 16, 17) and Dr. Wicker’s un rebutted testimony about how TGn-Sync is an extension of 802.11a (*see* Ex. 1002 ¶¶ 212–216), we are persuaded that an ordinarily skilled artisan would have had reasons to combine the references to make the claimed subject matter.

Having considered Petitioner’s contentions and evidence, we find that the combination of TGn-Sync and 802.11a teaches every limitation of claim 1. Petitioner also has provided persuasive reasons why an ordinarily skilled artisan would have made its proposed combination. On the entire trial record, we determine Petitioner has shown, by a preponderance of the evidence, that the subject matter of claim 1 would have been obvious over the combination of TGn-Sync and 802.11a.

4. *Claim 2*

Claim 2 is a method claim corresponding to claim 1. *Compare* Ex. 1001, 25:41–26:21, *with id.* at 26:22–42. Although claim 2 does not recite a generator or a transmitter, it recites corresponding generating and transmitting steps, as well as all other functions recited in claim 1. Petitioner relies on the same obviousness contentions for claim 2 as for claim 1. *See* Pet. 58–59.

For the same reasons discussed above with respect to claim 1 (*see supra* § II.D.3), we find that the combination of TGn-Sync and 802.11a teaches every limitation of claim 2. Petitioner also has provided persuasive reasons why an ordinarily skilled artisan would have made its proposed combination. On the entire trial record, we determine Petitioner has shown,

by a preponderance of the evidence, that the subject matter of claim 2 would have been obvious over the combination of TGn-Sync and 802.11a.

E. Obviousness Ground Based on Sun, 802.11a, and Larsson

Petitioner contends the subject matter of claims 1 and 2 would have been obvious over the combination of Sun, 802.11a, and Larsson. Pet. 59–80.

1. Sun

Sun is a U.S. patent describing a MIMO extension to 802.11a that uses multiple OFDM bins, i.e., subcarriers, to transmit information.

Ex. 1005, 9:19–27, 10:21–27, 14:32–36. Figure 7C of Sun is reproduced below.

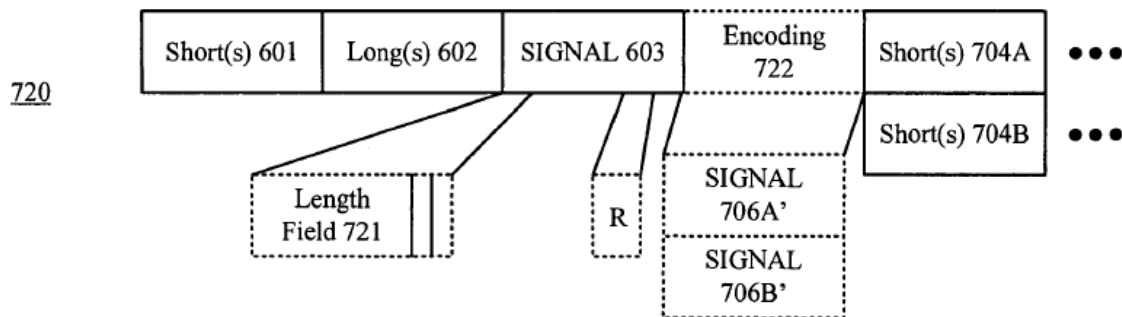


Figure 7C

Figure 7C depicts a MIMO burst format including, in order: a legacy non-MIMO training signal (including Short(s) 601 and Long(s) 602), a legacy non-MIMO control signal (Signal 603), a MIMO control signal (including encoding 722, Signal 706A', and Signal 706b'), and a MIMO training signal (including Short(s) 704A and Short(s) 704B). *Id.* at 9:46–59, 13:16–27, 14:6–19, 19:56–68, Fig. 7C. Sun further discloses that in a MIMO

transmission, MIMO data follows the MIMO training signal. *Id.* at 2:61–63, 3:66–4:11.

Sun also discloses using pilot tones to “track[] and correct[] phase variations of multiple received data symbols for a MIMO signal. Ex. 1005, 3:66–4:1. Sun explains that

a plurality of pilot bins can be inserted into each data symbol. In one embodiment, phase shifting can be added using a pattern across the plurality of pilot bins. For example, the pattern of the phase shifting can be rotated (e.g. cyclically) across the plurality of pilot bins. In one embodiment, four pilot bins can be inserted into each data symbol in a format of $[1 \ 1 \ 1 \ -1] * p_l$, wherein $[1 \ 1 \ 1 \ -1]$ is a pattern across the four pilot bins and p_l is a pilot polarity for symbol l .

Id. at 4:1–8.

Sun additionally discloses embodiments that use the prior art transmitter depicted in Figure 3. *See, e.g.*, Ex. 1005, 25:12–29. Figure 3 of Sun is reproduced below.

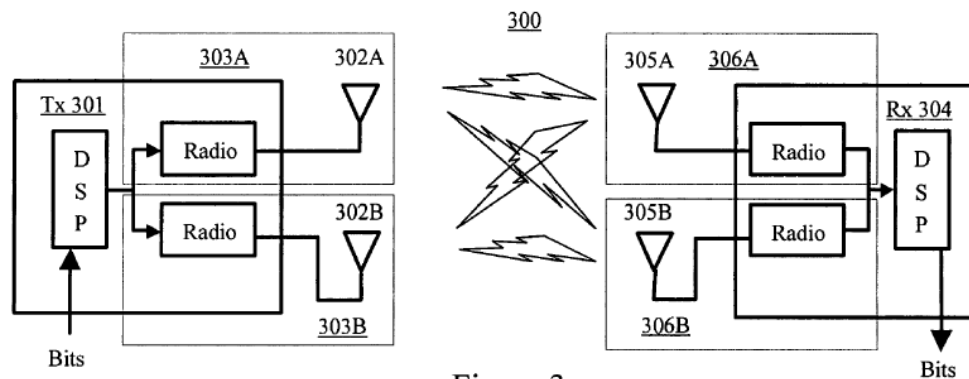


Figure 3

Figure 3 depicts a simplified MIMO system, including transmitter 301 and antennas 302A and 302B, “which can transmit on multiple antennas simultaneously and receive on multiple antennas simultaneously.” Ex. 1005, 1:49–55.

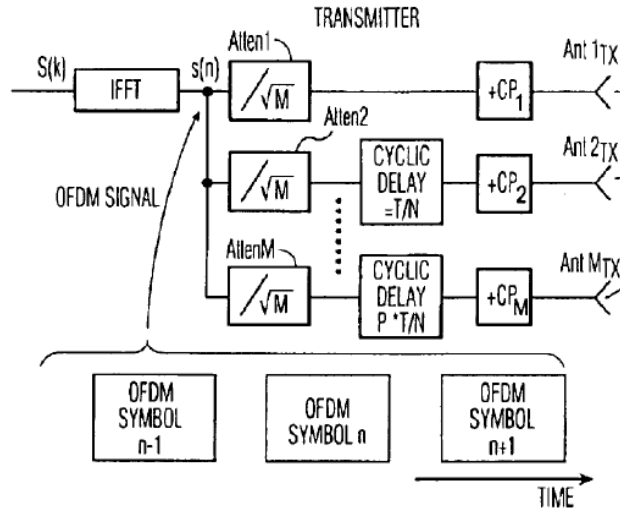
Sun claims priority to two different provisional applications. *See* Ex. 1005, code (60). Petitioner contends Sun qualifies as prior art under 35 U.S.C. § 102(e) based on the April 19, 2004, filing date of the later provisional application. Pet. 24–25; Ex. 1005, code (60). We have no evidence of an invention date other than the earliest possible effective filing date of the challenged claims. Thus, we determine that Sun qualifies as prior art under 35 U.S.C. § 102(e), because the April 19, 2004, filing date of Sun’s later provisional application is before the earliest possible effective filing date of the challenged claims, which is September 10, 2004. Ex. 1001, code (30); Ex. 1005, code (60).

2. *Larsson*

Larsson is a U.S. patent directed to using CDD to mitigate intersymbol interference in OFDM systems. Ex. 1006, 1:1–10. In particular, Larsson discloses

a method and/or an apparatus for transmitting a symbol, wherein the symbol is split among a plurality of antenna paths. In each antenna path the samples of the symbol are cyclically shifted a predetermined number of positions. The predetermined number of positions depends upon the relation of a particular antenna path with respect to the other antenna paths. Samples which are shifted out of the end of the symbol are inserted into the beginning of the symbol. Thereafter a cyclic prefix is formed by copying a predetermined number of samples from the end of the symbol.

Ex. 1006, 5:20–31; *see also id.* at 6:41–49. An excerpt from Figure 9 of Larsson is reproduced below.



The above excerpt of Figure 9 depicts a transmitter that operates according to an OFDM scheme employing transmitter diversity, and includes cyclic delay units $CYCLIC\ DELAY = T/N$ and $CYCLIC\ DELAY\ P \cdot T/N$, as well as antennas $Ant\ 1_{TX}$, $Ant\ 2_{TX}$, and $Ant\ M_{TX}$. Ex. 1006, 6:58–60, Fig. 9.

Larsson explains that CDD is useful for achieving frequency diversity for transmission, while preventing intersymbol interference between multiple paths, making it better than standard delay diversity. Ex. 1006, Abstract, 1:7–10, 5:9–11, 7:35–37. Larsson also states that insufficient delay between multipath signals could cause them to “add up in phase constructively or . . . cancel each other out.” *Id.* at 2:2–6.

Petitioner contends Larsson qualifies as prior art under 35 U.S.C. § 102(e) based on its September 22, 2000, filing date. Pet. 29; Ex. 1006, code (22). We have no evidence of an invention date other than the earliest possible effective filing date of the challenged claims. Thus, we determine that Larsson qualifies as prior art under 35 U.S.C. § 102(e), because its September 22, 2000, filing date is before the earliest possible effective filing date of the challenged claims, which is September 10, 2004. Ex. 1001, code (30); Ex. 1006, code (22).

3. *Claim 1*

We again consider whether Petitioner has met its burden of proving unpatentability by a preponderance of the evidence under 35 U.S.C. § 316(e).

The preamble of claim 1 recites “[a] transmitting apparatus for transmitting an OFDM signal.” Ex. 1001, 25:41–42. Petitioner cites Sun’s disclosure of a MIMO system, including a transmitter able to send both MIMO and non-MIMO OFDM signals. Pet. 61 (citing Ex. 1005, 1:26–28, 1:49–52, 1:59–62, 14:31–37). In particular, Petitioner points to Sun’s transmitter 301. *Id.* (citing Ex. 1005, Fig. 3). Thus, even if the preamble were considered limiting, the combination of Sun, 802.11a, and Larsson teaches the preamble of claim 1.

Claim 1 further recites “a generator operative to generate a burst signal having a first burst format where a first Non-MIMO training signal, a first Non-MIMO signal, a MIMO signal, a MIMO training signal, and first data are arranged in the stated order.” Ex. 1001, 25:43–26:3. Regarding the “generator operative to generate a burst signal having a first burst format” (Ex. 1001, 25:43–44), Petitioner cites Sun for teaching the construction and transmission of MIMO burst signals. Pet. 65 (citing Ex. 1005, 3:66–4:1, 4:9–11, 14:29–31, 27:10–13, Fig. 7C). With support from Dr. Wicker’s testimony, Petitioner asserts that “[i]t was known in the state of the art that processors or DSPs [digital signal processors] executed software to control generating burst signals. A skilled person would have included this known and conventional structure in Sun to manage burst generation.” *Id.* (citing Ex. 1002 ¶ 316; Ex. 1030, 11:3–5). According to Petitioner, the fact that Sun (as issued) included a DSP in the disclosed transmitter (Ex. 1005,

Fig. 3) further “supports that this design would have been obvious.”
Pet. 65–66.

As to the claimed first burst format, and its recited subcomponents, Petitioner contends that Sun discloses the required format. Pet. 61–65. For example, Petitioner identifies Figure 7C of Sun as disclosing a MIMO burst format. Figure 7C, as annotated by Petitioner, is reproduced below.

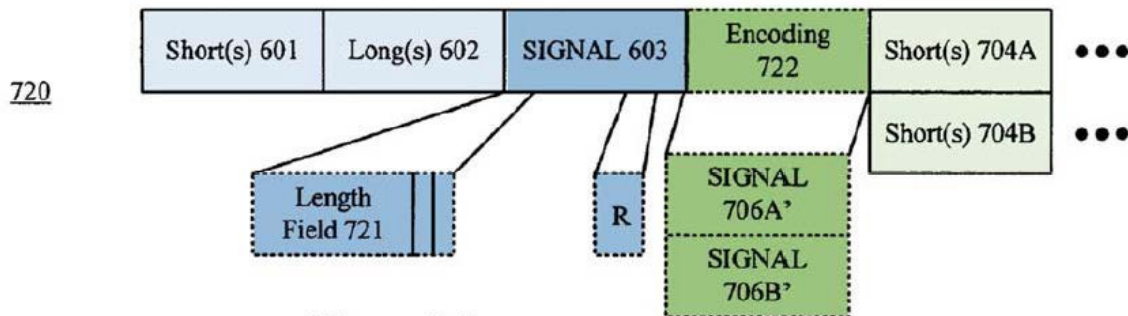


Figure 7C

Pet. 62. In this annotated version of Figure 7C, Petitioner depicts Sun’s MIMO burst format including, in order: a legacy non-MIMO training signal (including Short(s) 601 and Long(s) 602), a legacy non-MIMO control signal (Signal 603), a MIMO control signal (including encoding 722, Signal 706A’, and Signal 706b’), and a MIMO training signal (including Short(s) 704A and Short(s) 704B). Pet. 62–65 (citing numerous portions of Ex. 1005). Petitioner additionally asserts that Sun’s MIMO burst format included long training signal Long(s) 705, as well as MIMO data. Pet. 62, 65. According to Petitioner, an ordinarily skilled artisan would have understood that the “ellipses on the right-hand side of Figure 7C indicated where the Long(s) 705 training signals and MIMO data taught in Sun were appended to the burst, in that order.” *Id.* at 62 (citing Ex. 1002 ¶¶ 303–304, 312; Ex. 1005, 2:61–63, 3:66–4:11).

We are persuaded that an ordinarily skilled artisan would have considered Sun's transmitter 301, which includes a digital signal processor, radio circuitry, and antennas 302A and 302B, to be commensurate with the recited "generator." *See* Ex. 1002 ¶ 316; Ex. 1005, Fig. 3. Sun also teaches the recited burst format. *See* Ex. 1002 ¶¶ 303–304, 306, 308, 310, 312, 314; Ex. 1005, Fig. 7C. Thus, we find that the combination of Sun, 802.11a, and Larsson teaches the "generator" limitation of claim 1.

Claim 1 further recites "a transmitter operative to transmit the burst signal generated by the generator." Ex. 1001, 26:4–5. Petitioner cites transmitter 301 in Figure 3 of Sun. Pet. 70–71 (reproducing and annotating Ex. 1005, Fig. 3). Thus, we find that the combination of Sun, 802.11a, and Larsson teaches the "transmitter" limitation of claim 1.

Claim 1 further recites:

a subcarrier carrying a first pilot signal included by frequency-division multiplexing in the first data in the first burst format of the burst signal generated by the generator is the same as a subcarrier carrying a second pilot signal included by frequency-division multiplexing in second data in a second format where a second Non-MIMO training signal, a second Non-MIMO signal, and the second data are arranged in the stated order.

Ex. 1001, 26:6–13. As set forth above, we construe this claim limitation as requiring that at least one subcarrier carrying a pilot signal in a MIMO system is the same as at least one subcarrier carrying a pilot signal in a target system. *See supra* § II.C. Petitioner cites Sun for teaching this limitation.

Concerning the requirement for "second data in a second format where a second Non-MIMO training signal, a second Non-MIMO signal, and the second data are arranged in the stated order" (Ex. 1001, 26:11–13),

Petitioner asserts that Sun’s Figure 6 discloses a legacy header. Pet. 71–72. Figure 6 of Sun, as annotated by Petitioner, is reproduced below.

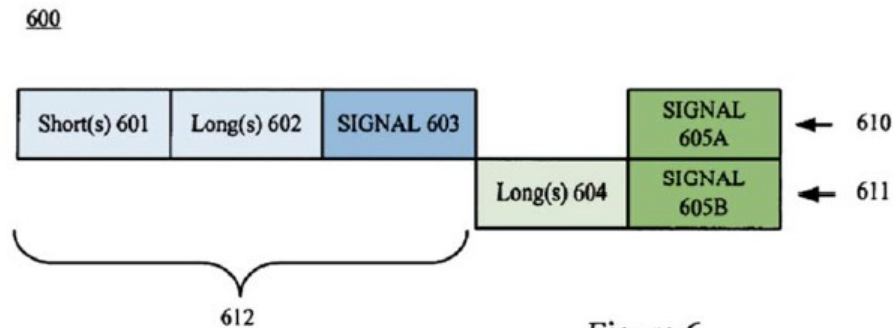


Figure 6

Pet. 72. According to Petitioner, annotated Figure 6 discloses a legacy header 612 that includes a non-MIMO training signal, including Short(s) 601 and Long(s) 602, as well as a non-MIMO control signal, SIGNAL 603. *Id.* at 71–72. Petitioner additionally asserts that Sun discloses “transmitting legacy packets that included legacy data.” *Id.* at 72 (citing Ex. 1005, 4:5–8, 13:12–15, 13:28–31, 14:31–35). Petitioner additionally cites the PPDU frame format disclosed in 802.11a and contends it discloses “the legacy header—preamble and control signal—followed by data.” *Id.* at 72 (citing Ex. 1004, 7, Fig. 107).

Turning to the requirement that “a subcarrier carrying a first pilot signal . . . is the same as a subcarrier carrying a second pilot signal” (Ex. 1001, 26:6–10), Petitioner asserts that

Sun explained that the legacy 802.11a system used four bins (subcarriers) to carry pilot signals (the “second pilot signal”) for non-MIMO OFDM data symbols in the second non-MIMO burst format. Sun then taught an embodiment where its system used the same four subcarriers as 802.11a to insert pilot signals (a “first pilot signal”) into MIMO OFDM symbols in the first MIMO burst format.

Pet. 73 (citing Ex. 1002 ¶ 329; Ex. 1005, 3:66–4:3, 4:5–11, 14:31–39).

We are persuaded by Petitioner’s analysis and find that the combination of Sun, 802.11a, and Larsson teaches the “subcarrier” limitation of claim 1. *See* Ex. 1002 ¶¶ 324–327, 329.

Claim 1 further recites “a modulation scheme of the first pilot signal is the same as a modulation scheme of the second pilot signal.” Ex. 1001, 26:14–15. Petitioner contends that Sun, alone or in combination with 802.11a, teaches this limitation. Pet. 75–76. First, Petitioner contends that use of OFDM by Sun for MIMO and non-MIMO transmissions satisfies this claim limitation. *Id.* at 75 (citing Ex. 1005, 14:31–37). Second, similar to its analysis in the TGN-Sync–802.11a ground (*see supra* § II.D.3), Petitioner notes “the 802.11a pilot signal values of 1, 1, 1, -1 that Sun used as the initially-assigned legacy and MIMO pilot signal pattern included just two I values: 1 or -1.” *Id.* (citing Ex. 1002 ¶ 329; Ex. 1004, 22; Ex. 14:31–35). According to Petitioner, “802.11a (the source of the pilot pattern) taught that BPSK modulation applied to this type of signal, and a skilled person would have used that approach on Sun’s legacy and MIMO pilot signals given its simplicity and efficiency.” *Id.* at 75–76 (citing Ex. 1002 ¶ 338; Ex. 1004, 19–22). In addition, Petitioner notes “Sun referred to 802.11a’s teachings about pilot signal format and BPSK modulation.” *Id.* at 76 (citing Ex. 1005, 4:5–8, 14:31–35, 17:28–31).

We are persuaded by Petitioner’s analysis, and we find that the combination of Sun, 802.11a, and Larsson teaches the “modulation scheme” limitation of claim 1.

Claim 1 further recites “a pattern of the first pilot signal is different from a pattern of the second pilot signal.” Ex. 1001, 26:16–17. According to Petitioner, “Sun taught different pilot signals based on different polarity

sequences for MIMO and non-MIMO bursts.” Pet. 74. In this regard, Petitioner asserts that

Sun disclosed that the initially-assigned pilot signal pattern for non-MIMO legacy burst data was 1, 1, 1, -1 as modulated by the pilot polarity sequence p_l defined in 802.11a. Sun taught that the MIMO burst used “the same pilot format as 802.11a/g.” Sun also disclosed that different antennas used different pilot polarity sequences when transmitting MIMO data.

Id. (citing Ex. 1005, 14:31–35, 14:38–39, 15:39–43). Petitioner further cites the following table from Sun showing exemplary pilot polarity sequences for three transmit antennas:

$$\begin{array}{cccccc} p_0 & p_1 & p_2 & p_3 & p_4 & \dots \\ p_0 & p_1 e^{j2\pi/3} & p_2 e^{-j2\pi/3} & p_3 & p_4 e^{j2\pi/3} & \dots \\ p_0 & p_1 e^{-j2\pi/3} & p_2 e^{j2\pi/3} & p_3 & p_4 e^{-j2\pi/3} & \dots \end{array}$$

Ex. 1005, 15:54–59. Relying on Dr. Wicker, Petitioner explains Sun’s table as follows:

The table indicates that the first antenna (corresponding to the first row) used the 802.11a pilot polarity sequence without modification. The second and third antennas alter the pilot signals for each symbol ($p_0, p_1, p_2, \dots$) using complex multiplication (the natural exponentiation can be expanded using Euler’s formula). After that multiplication, the pilot signal patterns for the second and third antennas differed from the legacy pilot signal pattern.

Pet. 75–75 (citing Ex. 1002 ¶ 333). Petitioner further contends that “it would have been obvious to a skilled person to use a different initially-assigned pilot signal pattern for non-MIMO and MIMO bursts,” because “[p]ilot signals were well known in the art and adjusting the values was a trivial exercise.” *Id.* at 75 (citing Ex. 1002 ¶¶ 334–335, Ex. 1003, 123, Ex. 1004, 22, Ex. 1005, 14:64–15:2).

We are persuaded by Petitioner’s analysis and find that for the reasons given, the combination of Sun, 802.11a, and Larsson teaches the “pattern” limitation of claim 1.

The final limitation in claim 1 recites “the transmitter transmits the burst signal from a plurality of antennas such that the signal transmitted from a given one antenna is shifted in timing with respect to the signal transmitted from another antenna in a cyclical manner.” Ex. 1001, 26:18–21. Petitioner contends that Larsson discloses this claim element. Pet. 76–77 (citing Ex. 1006, 5:20–31, 6:41–49. For example, Petitioner contends Larsson discloses the implementation of CDD in an OFDM system in its Figure 8, which is reproduced below.

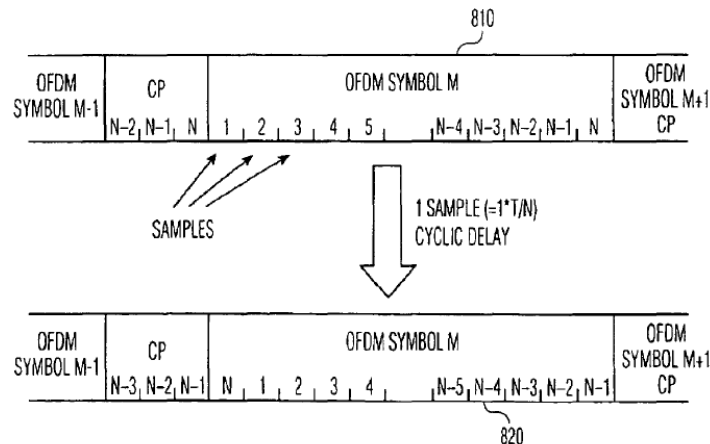


FIG. 8

Id. at 77. Figure 8 “illustrates two OFDM symbols wherein a cyclic delay is implemented between the two symbols being transmitted in a transmission diversity scheme.” Ex. 1006, 6:39–41. According to Petitioner, in Figure 8, the “OFDM samples shifted right and ‘N’ shifted to the beginning of OFDM symbol M.” Pet. 77 (citing Ex. 1006, 6:41–45). Petitioner also asserts that Figure 9 of Larsson “depicts the insertion of a cyclic delay . . . of the same

OFDM signal before transmission on antennas 2 and M.” *Id.* (citing Ex. 1006, Fig. 9).

Petitioner additionally contends that Larsson teaches several benefits of CDD. Pet. 78. Specifically, Petitioner cites Larsson’s teaching that CDD uses a “cyclical shift to achieve frequency diversity without the limitations of standard techniques based on linear delay, such as an increased risk of interference and restrictions on the number of antennas that can be used.” *Id.* (citing Ex. 1002 ¶¶ 343–344; Ex. 1006, 7:26–37). Petitioner further contends that Larsson discloses the “possibility of beamforming effects where transmitting the same signal on multiple antennas can potentially overwhelm a receiver or violate FCC rules.” *Id.* (citing Ex. 1002 ¶¶ 211, 219, 344; Ex. 1006, 2:2–6). We are persuaded by Petitioner’s analysis and find that the combination of Sun, 802.11a, and Larsson teaches the final limitation of claim 1.

Petitioner contends that an ordinarily skilled artisan would have sought to combine Sun with 802.11a because Sun suggests the combination. Pet. 28–30. In support of its contention, Petitioner points out that “Sun built on the teachings of 802.11a, disclosed a system designed to be backwards compatible with 802.11a, and referred to 802.11a’s teachings, including for burst format, transmitter blocks and modulation.” *Id.* at 28–30 (citing Ex. 1005, 1:15–27, 9:23–36, 17:27–50); *see also id.* at 60 (same argument).

Petitioner further asserts “it would have been obvious for a skilled person to incorporate CDD into Sun’s system based on Larsson’s disclosure of that technique.” Pet. 76 (citing Ex. 1006, 5:20–31, 6:41–49). Petitioner argues an ordinarily skilled artisan would have added Larsson to the combination of Sun and 802.11a because CDD “was a known technique (as

disclosed in Larsson) that would have been used to obtain predictable results (increasing frequency diversity and preventing beamforming) to improve the Sun and 802.11a system.” Pet. 30; *see also id.* at 60 (same argument). In this regard, Petitioner asserts that “Larsson disclosed that CDD was useful for achieving frequency diversity for transmission while preventing intersymbol interference [i.e., beamforming] between multiple paths, making it better than standard delay diversity.” *Id.* at 30 (citing Ex. 1006, Abstract, 1:7–10, 5:9–11, 7:35–37; Ex. 1002 ¶¶ 218–219); *see also id.* at 78 (same argument). Relying on testimony from Dr. Wicker, Petitioner also states that at the time of invention of the ’400 patent, using CDD was a known way to prevent the risks associated with beamforming, which include, for example, the risk of overwhelming the receiver or violating FCC regulations. *Id.* (citing Ex. 1002 ¶¶ 211, 219, 220, 344); *see also id.* at 78 (same argument). Petitioner contends an ordinarily skilled artisan would have incorporated Larsson’s CDD technique in order to obtain these benefits. *Id.* at 78 (citing Ex. 1002 ¶ 346). Petitioner further observes that the provisional application to which Sun claims priority disclosed using phase shifting, which can be accomplished using CDD, and that Sun as-issued teaches CDD and discloses that CDD prevents beamforming.⁵ *Id.* (citing Ex. 1002 ¶ 220; Ex. 1006, 12:60–13:3).

We are persuaded by Petitioner’s reasons for making the combination. Sun references 802.11a and states expressly that its system is designed to be

⁵ Petitioner apparently does not rely on the disclosure of CDD by Sun because, in Petitioner’s view, the later provisional application to which Sun claims priority does not expressly mention that technique. *See* Pet. 24–25, 29, 60, 76. Nonetheless, the issued version of Sun mentions CCD. *See id.* at 29 (citing Ex. 1005, 12:67–13:3).

backwards compatible with 802.11a. *See* Ex. 1005, 1:15–27, 9:23–36.

Dr. Wicker also provides un rebutted and persuasive testimony that an ordinarily skilled artisan would have incorporated Larsson’s CDD technique into the wireless MIMO-OFDM system of Sun and 802.11a to mitigate the effects of accidental beamforming and to obtain the benefits of frequency diversity. *See* Ex. 1002 ¶ 222.

Having considered Petitioner’s contentions and evidence, we find that the combination of Sun, 802.11a, and Larsson teaches every limitation of claim 1. Petitioner also has provided persuasive reasons why an ordinarily skilled artisan would have made its proposed combination. On the entire trial record, we determine Petitioner has shown, by a preponderance of the evidence, that the subject matter of claim 1 would have been obvious over the combination of Sun, 802.11a, and Larsson.

4. *Claim 2*

Claim 2 is a method claim corresponding to claim 1. *Compare* Ex. 1001, 25:41–26:21, *with id.* at 26:22–42. Although claim 2 does not recite a generator or a transmitter, it recites corresponding generating and transmitting steps, as well as all other functions recited in claim 1. Petitioner relies on the same obviousness contentions for claim 2 as for claim 1. *See* Pet. 79–80.

For the same reasons discussed above with respect to claim 1 (*see supra* § II.E.3), we find that the combination of Sun, 802.11a, and Larsson teaches every limitation of claim 2. Petitioner also has provided persuasive reasons why an ordinarily skilled artisan would have made its proposed combination. On the entire trial record, we determine Petitioner has shown,

by a preponderance of the evidence, that the subject matter of claim 2 would have been obvious over the combination of Sun, 802.11a, and Larsson.

III. PATENT OWNER'S CONTINGENT MOTION TO AMEND

Pursuant to 35 U.S.C. § 316(d)(1) and 37 C.F.R. § 42.121(a), Patent Owner moves to replace claims 1 and 2 of the '400 patent with proposed substitute claims 3 and 4, respectively. Mot. to Amend 1. The motion is contingent on our determination as to whether a preponderance of the evidence establishes that claims 1 and 2 of the '400 patent are unpatentable. *Id.* As discussed above, we determine that original claims 1 and 2 of the '400 patent have been shown to be unpatentable by a preponderance of the evidence. *See supra* §§ II.D.3–4, II.E.3–4. Therefore, we proceed to address Patent Owner's contingent motion to amend.

A. *Proposed Substitute Claims*

Patent Owner's proposed substitute claims 3 and 4 are reproduced below with Petitioner's bracketed labels to identify claim limitations and underlining indicating text added to claims 1 and 2, respectively.

3. [3.P] A transmitting apparatus for transmitting an OFDM signal, comprising:

[3.1] a generator operative to generate a burst signal having a first burst format where a first Non-MIMO training signal, a first Non-MIMO signal, a MIMO signal, a MIMO training signal, and first data are arranged in the stated order; and

[3.2] a transmitter operative to transmit the burst signal generated by the generator,

[3.3] wherein a first subcarrier carrying a first pilot signal included by frequency-division multiplexing in the first

data in the first burst format of the burst signal generated by the generator is the same as a second subcarrier carrying a second pilot signal included by frequency-division multiplexing in second data in a second format,

[3.4] wherein the first pilot signal is assigned to the first subcarrier which corresponds to the same frequency as the second subcarrier carrying the second pilot signal,

[3.5] wherein a second Non-MIMO training signal, a second Non-MIMO signal, and the second data are arranged in the stated order,

[3.6] wherein a modulation scheme of the first pilot signal is the same as a modulation scheme of the second pilot signal and MIMO pilot signals have a same signal point constellation as target pilot signals,

[3.7] wherein the first pilot signal and the second pilot signal are both assigned to subcarrier numbers: -21, -7, 7 and 21,

[3.8] wherein a pattern of the first pilot signal is different from a pattern of the second pilot signal, and

[3.9] the transmitter transmits the burst signal from a plurality of antennas such that the signal transmitted from a given one antenna is shifted in timing with respect to the signal transmitted from another antenna in a cyclical manner,

[3.10] wherein the transmitted burst signal is configured to suppress an increase in power consumption at a receiving apparatus even if the transmitted burst signal is not compatible with the receiving apparatus.

4. [4.P] A transmitting method for transmitting an OFDM signal, comprising:

[4.1] generating a burst signal having a first burst format where a first Non-MIMO training signal, a first Non-MIMO signal, a MIMO signal, a MIMO training signal, and first data are arranged in the stated order; and

[4.2] transmitting the burst signal,

[4.3] wherein a first subcarrier carrying a first pilot signal included by frequency-division multiplexing in the first data in the first burst format of the burst signal generated by the generator is the same as a second subcarrier carrying a second pilot signal included by frequency-division multiplexing in second data in a second format,

[4.4] wherein the first pilot signal is assigned to the first subcarrier which corresponds to the same frequency as the second subcarrier carrying the second pilot signal,

[4.5] wherein a second Non-MIMO training signal, a second Non-MIMO signal, and the second data are arranged in the stated order,

[4.6] wherein a modulation scheme of the first pilot signal is the same as a modulation scheme of the second pilot signal and MIMO pilot signals have a same signal point constellation as target pilot signals,

[4.7] wherein the first pilot signal and the second pilot signal are both assigned to subcarrier numbers: -21, -7, 7 and 21,

[4.8] wherein a pattern of the first pilot signal is different from a pattern of the second pilot signal, and

[4.9] the transmitting transmits the burst signal from a plurality of antennas such that the signal transmitted from a given one antenna is shifted in timing with respect to the signal transmitted from another antenna in a cyclical manner,

[4.10] wherein the transmitted burst signal is configured to suppress an increase in power consumption at a receiving apparatus even if the transmitted burst signal is not compatible with the receiving apparatus.

Mot. to Amend 11–14. In our analysis below, we adopt Petitioner’s bracketed labels to more efficiently identify limitations.

B. Procedural Requirements

“Before considering the patentability of any substitute claims, . . . the Board first must determine whether the motion to amend meets the statutory and regulatory requirements set forth in 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121.” *Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 15, 4–8 (PTAB Feb. 25, 2019) (precedential) (“*Lectrosonics*”).

1. Claim Listing

The motion to amend includes a claim listing, as required by 37 C.F.R. § 42.121(b). Mot. to Amend 11–14; *Lectrosonics* at 8.

2. Reasonable Number of Substitute Claims

We now consider whether the motion to amend proposes a reasonable number of substitute claims. 35 U.S.C. § 316(d)(1)(B). “There is a rebuttable presumption that a reasonable number of substitute claims per challenged claim is one (1) substitute claim.” *Lectrosonics* at 4–5 (citing 37 C.F.R. § 42.121(a)(3)). The Petition challenges 2 claims, the motion to amend proposes 2 substitute claims. Mot. to Amend 1. We determine that the number of proposed claims is reasonable.

3. Respond to a Ground of Unpatentability Involved in the Trial

Next, we consider whether the proposed substitute claims respond to a ground of unpatentability involved in this trial. *Lectrosonics* at 5–6. Patent Owner argues the motion to amend is responsive to the instituted grounds insofar as it proposes adding, *inter alia*, the following limitation to claims 1 and 2, resulting in proposed substitute claims 3 and 4:

wherein the transmitted burst signal is configured to suppress an increase in power consumption at a receiving apparatus even if the transmitted burst signal is not compatible with the receiving apparatus.

Mot. to Amend 8–9. Patent Owner also highlights this added limitation in asserting that the proposed substitute claims are patentable over the references in the instituted grounds. *See id.* at 9–10. Based on Patent Owner’s showing, we determine that the amended language in the proposed substitute claims is responsive to the grounds of unpatentability involved in this trial.

4. *No Enlargement to the Scope of the Claims*

We also consider the breadth of the substitute claims. “A motion to amend may not present substitute claims that enlarge the scope of the claims of the challenged patent or introduce new subject matter.” *Lectrosonics* at 6–7 (citing 35 U.S.C. § 316(d)(3); 37 C.F.R. § 41.121(a)(2)(ii)). For both substitute claims, Patent Owner’s proposed amendment adds several limitations, including the one reproduced in the prior paragraph. We determine that these added limitations in proposed substitute claims 3 and 4 result in claims that are narrower than claims 1 and 2, respectively.

5. *No New Matter*

We now consider whether the substitute claims 3 and 4 have introduced new matter. “[T]he Board requires that a motion to amend set forth written description support in the originally filed disclosure of the subject patent for each proposed substitute claim, and also set forth support in an earlier filed disclosure for each claim for which benefit of the filing

date of the earlier filed disclosure is sought.” *Lectrosonics* at 7 (citing 37 C.F.R. § 42.121(b)(1)–(2)). For this requirement, Patent Owner must cite “to the *original disclosure of the application*, as filed, rather than to the patent as issued.” *Id.* at 8 (emphasis added). We now consider whether Patent Owner’s proposed substitute claims introduce new matter.

a. The Priority Document to Which Patent Owner
Must Cite for Written Description Support

In the motion to amend, Patent Owner provides a listing indicating where each limitation of the substitute claims is supported in the specification of the ’400 patent as issued. *See* Mot. to Amend 5–8. Although Patent Owner states that “[c]itations for support are also made to the Patent Application as originally filed” (Mot. to Amend 5 (citing Ex. 1008, 1–93)), Patent Owner’s listing does not include specific citations to the originally filed U.S. application. Patent Owner also mentions the two Japanese patent applications to which the ’400 patent claims priority, but does not include specific citations to the Japanese applications. *Id.* (citing Ex. 1008, 108–85). In addition, the Japanese patent applications in the instant record appear in the Japanese language, and Patent Owner does not include English translations. *See* Ex. 1008, 108–85.

Petitioner argues Patent Owner’s failure to specify written description support in the earliest disclosure to which priority is claimed (i.e., the Japanese applications) contravenes our rules and amounts to a procedural fault that justifies denying Patent Owner’s motion to amend. *Opp.* 2. Petitioner also argues that Patent Owner’s general citations to the entire range of pages including the U.S. application and the Japanese applications are not sufficient. *Pet. Sur-reply* 2.

In reply, Patent Owner presents a fallback position: that its citations to the specification of the '400 patent are at least sufficient to show support as of the filing date of the U.S. patent application. *See* PO Reply 3.

Patent Owner has provided citations to the issued '400 patent, and those citations appear to be supported by the U.S. application for the '400 patent provided in Exhibit 1008. Thus, we will assume for purposes of this Decision that Patent Owner's listing is sufficient proof that the specification of the '400 patent provides written description support at least as of the filing date of the U.S. application that led the '400 patent. For purposes of our analysis, we consider the effective filing date of Patent Owner's proposed substitute claims to be September 9, 2005. Ex. 1001, code (22).

b. Support for the “even if” Language in
Limitations 3.10 and 4.10

Petitioner argues that, based on their “even if” language, limitations 3.10 and 4.10 cover a MIMO burst configured to suppress power consumption in *any* receiver, including a MIMO receiver, but that suppressing power in MIMO receivers is not supported in the U.S. application. Pet. Opp. 8–9; Pet. Sur-reply 5–7. According to Petitioner, limitations 3.10 and 4.10 imply that the transmitted MIMO burst signal would be configured to suppress an increase in power consumption both (1) when the transmitted burst signal *is* compatible with the receiving apparatus (i.e., a MIMO receiver), and (2) when the transmitted burst signal *is not* compatible with the receiving apparatus (i.e., a non-MIMO receiver). Petitioner further notes that the U.S. application only supports the reduction

of power consumption in a non-MIMO receiver. *Id.* at 9 (citing Ex. 1008, 42, 52; Ex. 1036 ¶ 29).

In reply, Patent Owner argues that limitations 3.10 and 4.10 are directly supported in the specification of the '400 patent. PO Reply 2–3 (citing Ex. 1001, 2:16–23).

The specification of the U.S. application states:

The present invention has been made in view of the foregoing circumstances and an object thereof is to provide a receiving method and apparatus by which to suppress the increase in power consumption *even if* a burst signal in a communication system which is not compatible with the receiving apparatus arrives, and to provide also a communication system utilizing said receiving method and apparatus.

Ex. 1008, 5 (emphasis added); *see also* Ex. 1001, 2:16–22 (corresponding sentence in the issued '400 patent). As such, Patent Owner is correct (PO Reply 2–3) that the U.S. application uses the same “even if” formulation as in limitations 3.10 and 4.10. Nevertheless, the U.S. application only discloses suppressing increases in power consumption in non-MIMO receivers. *See* Ex. 1008, 42–43, 52–53. Thus, we agree with Petitioner that the U.S. application does not support the use of MIMO burst signals to suppress power increases in MIMO receivers. Pet. Opp. 9 (citing Ex. 1036 ¶ 29). Accordingly, we treat this as a limitation on the scope of the claims, as discussed below. *See infra* § III.C.

c. Support for the “first pilot signal” in a MIMO Data Field

Petitioner argues that the U.S. application does not disclose the claimed “first pilot signal” in a MIMO data field. Pet. Opp. 5–8; Pet.

Sur-reply 3–5. Limitations 3.3 and 4.3 both recite “a first subcarrier carrying a first pilot signal included by frequency-division multiplexing in the first data in the first burst format.” Mot. to Amend 11. Petitioner notes that the “first burst format” is recited to be a MIMO burst in limitation 3.1.⁶ Pet. Opp. 5–6 (citing Ex. 1001, Fig. 4B; Ex. 1008, 32); *see also* Ex. 1002 ¶¶ 136, 138, 231 (Dr. Wicker explaining the MIMO burst format in Figure 4B of the ’400 patent and likening it the language of limitation 3.1). Petitioner further notes that the invention described in the U.S. application “enables a target (non-MIMO) receiver to distinguish between target and MIMO bursts by detecting differences, for example, in the ‘data signal’ of a target burst versus the ‘control signal’ or ‘MIMO signal’ of a MIMO burst.” Pet. Opp. 6 (citing Ex. 1008, 5–6, 10–12, 18–19, 21); *see also* Ex. 1036 ¶ 25 (Dr. Wicker discussing same). This allows a non-MIMO receiver to stop processing MIMO bursts and save power. Pet. Opp. 6, 7; *see also* Mot. to Amend 12 (limitation 3.10 directed to suppressing an increase in power consumption at a receiver for an incompatible burst signal).

In contrast, according to Petitioner, the U.S. application “does not mention pilot signals in a MIMO *data* field, and the disclosed judgment unit does not use them.” Pet. Opp. 7 (citing Ex. 1008, 53–56); Pet. Sur-reply 4; *see also* Ex. 1036 ¶ 25 (Dr. Wicker discussing same). Dr. Wicker similarly testifies that “[n]either the ‘Summary of the Invention’ section nor the ‘Third Embodiment’ section of the original application discloses using a pattern of the pilot signals in the MIMO data field for burst type detection.” Ex. 1036 ¶ 25. Indeed, Petitioner explains that using pilot signals in MIMO data

⁶ Limitation 4.1 recites the same language.

would be contrary to the power savings in non-MIMO receivers the U.S. application attempted to achieve by *not* processing signals in MIMO data. Pet. Opp. 7–8 (citing Ex. 1008, 5, 53; Ex. 1036 ¶¶ 26–27); Pet. Sur-reply 4 (citing Ex. 1008, 53–54, 57–58, 90, 91). Thus, Petitioner contends an ordinarily skilled artisan would not have understood “that the inventor possessed pilot signals in the MIMO *data* field that a receiver can use to detect a MIMO burst and suppress power consumption, as required by the claims.” Pet. Opp. 8 (citing Ex. 1036 ¶ 28).

In reply, Patent Owner argues Petitioner attempts “to draw distinctions between a ‘data signal’ and ‘control signal,’” but that “these terms . . . do not appear in the proposed amended claims.” PO Reply 2. Patent Owner also argues that Petitioner improperly “incorporat[es] these additional features into the proposed amended claims by purportedly equating them with features already present in the claim.” *Id.* Patent Owner also characterizes Petitioner’s reading of the patent specification as “constrictive.” *Id.*

We are persuaded by Petitioner’s arguments. We have reviewed Patent Owner’s asserted support in the specification for proposed substitute claims 3 and 4 (*see* Mot. to Amend 5–8), and we agree with Petitioner that no part of the specification (or its corresponding U.S. application) supports the use of a pilot signal in the *data* field of a MIMO burst for burst type detection. Pet. Opp. 7. Dr. Wicker’s supporting testimony on this point is un rebutted. Ex. 1036 ¶ 25. We further agree with Petitioner that Petitioner’s references to “data signal” and “control signal” correspond to the specification’s own description of a non-MIMO data field and a MIMO signal field, respectively. Pet. Sur-reply 4 (citing Ex. 1008, 5–6, 17, 25, 32,

38). In this way, Petitioner’s arguments pertain to limitations 3.1, 3.5, 4.1, and 4.5. Finally, Patent Owner’s argument about Petitioner’s allegedly “constrictive” reading of the specification is devoid of explanation or evidence to the contrary. Thus, we determine the U.S. application lacks written description support for a pilot signal in the MIMO *data* field that a receiver can use to detect and stop processing a MIMO burst.

6. *Conclusion Regarding Procedural Requirements*

In view of the above, we determine that Patent Owner’s motion to amend does not meet all of the statutory and regulatory requirements of 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121. In particular, Patent Owner does not show written description support for the “first pilot signal” being in a MIMO data field. *See* 37 C.F.R. § 42.121(b). Nevertheless, for completeness, we proceed to consider whether Petitioner has met its burden of persuasion with respect to patentability. *Lectrosonics*, Paper 15 at 3–4 (“[A]s a result of the current state of the law and USPTO rules and guidance, the burden of persuasion ordinarily will lie with the petitioner to show that any proposed substitute claims are unpatentable by a preponderance of the evidence.”); *see also Aqua Products v. Matal*, 872 F.3d 1290 (Fed. Cir. 2017) (holding that, in the absence of a rule stating otherwise, the Board must assess the patentability of proposed substitute claims “without placing the burden of persuasion on the patent owner”); *Bosch Automotive Service Solutions, LLC v. Matal*, 878 F.3d 1027, 1040 (Fed. Cir. 2017) (“the petitioner bears the burden of proving that the proposed amended claims are unpatentable by a preponderance of the evidence”).

C. Claim Construction

As discussed above, limitations 3.10 and 4.10 are susceptible to a reading whereby they cover suppressing power increases in MIMO receivers. *See supra* § III.B.5.b. Nevertheless, the U.S. application only discloses suppressing increases in power consumption in non-MIMO receivers. *See* Ex. 1008, 42–43, 52–53. Thus, for purposes of this Decision, we construe limitations 3.10 and 4.10 to only cover suppressing increases in power consumption in non-MIMO receivers. Such a construction is consistent with the extent to which limitations 3.10 and 4.10 are supported in the U.S. application.

D. Whether the Substitute Claims Comply with 35 U.S.C. § 112 ¶ 2

For purposes of this Decision, we determine that Patent Owner’s proposed substitute claims particularly point out and distinctly claim the invention. Petitioner does not put forth any arguments to the contrary.

E. Patentability of Substitute Claims over TGn-Sync, 802.11a, and Li

Petitioner contends the subject matter of proposed substitute claims 3 and 4 would have been obvious over the combination of TGn-Sync, 802.11a, and U.S. Patent No. 7,110,350 B2 (Ex. 1037, “Li”). Pet. Opp. 10–22; Pet. Sur-reply 8–12. Patent Owner disputes Petitioner’s contentions. Mot. to Amend 9–10; PO Reply 4–6.

1. Li

Li is a U.S. patent directed to “a MIMO system which is configured with backward compatibility with wireless LAN (WLAN) technology.”

Ex. 1037, 1:22–25. Li mentions IEEE 802.11 standards, including 802.11a, and Li states that 802.11a has been designed for single-input single-output (SISO) systems. *See id.* at 1:29–52. Figure 6 of Li is reproduced below.

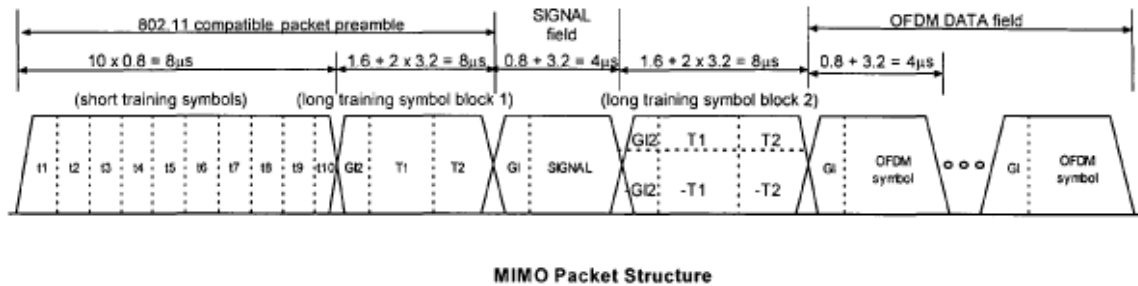


FIG. 6

Figure 6 depicts a timing diagram illustrating a MIMO packet structure. *Id.* at 4:26–28. To ensure backward compatibility with a conventional SISO arrangement, identical short training symbols are used in the MIMO system as in the SISO preamble for the transmit antennas of the MIMO system. *Id.* at 4:31–35. A SISO receiver can successfully detect up to the SIGNAL field, which remains the same for both transmit antennas. *Id.* at 4:46–49. Using a reserved bit within the SIGNAL field, the SISO receiver can stop its operation whenever a MIMO transmission follows. *Id.* at 4:49–52.

Petitioner contends Li qualifies as prior art under 35 U.S.C. § 102(e) based on its March 5, 2004, filing date.⁷ Pet. Opp. 22; Ex. 1037, code (22). Patent Owner does not dispute the prior art status of Li. We have no evidence of an invention date other than the earliest possible effective filing date of the proposed substitute claims, which is September 9, 2005, as discussed above. *See supra* § III.B.5.a; Ex. 1001, code (22). Thus, we determine that Li qualifies as prior art under 35 U.S.C. § 102(e), because its

⁷ In its Opposition, Petitioner mistakenly lists Li's filing date at March 4, 2004. Pet. Opp. 22.

March 5, 2004, filing date is before the earliest possible effective filing date of the proposed substitute claims, which is September 9, 2005. Ex. 1001, code (22); Ex. 1037, code (22).

2. *Proposed Substitute Claim 3*

The preamble of proposed substitute claim 3 and claim limitations 3.1, 3.2, 3.3, 3.5, 3.8, and 3.9 have not changed substantively from their corresponding recitations in claim 1. *See* Mot. to Amend 11–12. Petitioner relies on the same obviousness contentions discussed above with respect to the TGn-Sync–802.11a ground. Pet. Opp. 10–11, 11 n.2. Patent Owner does not dispute Petitioner’s contentions with respect to the preamble and these limitations. Thus, for the same reasons discussed above in the analysis for the TGn-Sync–802.11a ground (*see supra* § II.D.3), we find that the combination TGn-Sync, 802.11a, and Li teaches the preamble (even if it were considered limiting) and limitations 3.1, 3.2, 3.3, 3.5, 3.8, and 3.9.

Limitation 3.4 recites “wherein the first pilot signal is assigned to the first subcarrier which corresponds to the same frequency as the second subcarrier carrying the second pilot signal.” Mot. to Amend 12. Petitioner contends this limitation “relates to pilot signals in the *data* field of a MIMO burst and in the data field of a non-MIMO burst.” Pet. Opp. 12; *see also* Ex. 1036 ¶ 35. According to Petitioner, “TGn-Sync taught, and in combination with 802.11a renders obvious, using the same subcarriers to carry pilot signals in the data fields of MIMO and non-MIMO bursts.” Pet. Opp. 12 (citing Ex. 1036 ¶¶ 36–39). Specifically, Petitioner cites TGn-Sync’s teaching of “a 20 MHz mode where subcarrier numbers -21, -7, 7, and 21 each carry a separate pilot signal in the data field of a MIMO burst

(i.e., a first pilot signal).” *Id.* (citing Ex. 1003, 116:5, 120:14–15, 122:8–10, 122:22–27). Correspondingly, Petitioner cites 802.11a’s teaching of “subcarrier numbers -21, -7, 7, and 21 each carry[ing] a separate pilot signal in the data field of a non-MIMO burst (i.e., a second pilot signal).” *Id.* at 12–13 (citing Ex. 1004, 15, 22, 23). Patent Owner does not dispute Petitioner’s analysis for limitation 3.4. We are persuaded by Petitioner’s analysis, and we find the combination of TGn-Sync, 802.11a, and Li teaches limitation 3.4.

Limitation 3.7 recites “wherein the first pilot signal and the second pilot signal are both assigned to subcarrier numbers: -21, -7, 7 and 21.” Mot. to Amend 12. Petitioner references the same analysis for limitation 3.4 discussed directly above. Patent Owner does not dispute Petitioner’s analysis for limitation 3.7. Based on Petitioner’s showing, we find the combination of TGn-Sync, 802.11a, and Li teaches limitation 3.7.

Limitation 3.6 recites “wherein a modulation scheme of the first pilot signal is the same as a modulation scheme of the second pilot signal and MIMO pilot signals have a same signal point constellation as target pilot signals.” Mot. to Amend 12. For “a modulation scheme of the first pilot signal is the same as a modulation scheme of the second pilot signal,” which is unmodified from claim 1, Petitioner relies on the same analysis discussed above with respect to the TGn-Sync–802.11a ground. Pet. Opp. 10–11, 11 n.2. Regarding the recited “MIMO pilot signals,” Petitioner cites TGn-Sync’s pilot signals in a field known as HT-SIG, which is a MIMO signal field. *Id.* (citing Ex. 1003, 94:22–25, 101:8–11). For “target pilot signals,” Petitioner cites 802.11a’s teaching of “four pilot signals in each

OFDM symbol in the data field of a non-MIMO burst.” *Id.* (citing Ex. 1004, 13, 15, 22–23, 62–63, 72).

Regarding the “same signal point constellation” limitation, Petitioner explains this “refers to the discrete set of possible values that are to be modulated onto a subcarrier in a wireless OFDM transmission.” Pet. Opp. 15 (citing Ex. 1036 ¶ 10). Petitioner notes that 802.11a teaches four non-MIMO pilot signals having values of 1, 1, 1, -1. *Id.* at 15 (citing, *inter alia*, Ex. 1004, 22). Petitioner further notes TGn-Sync teaches inverting the pilot polarity for a MIMO burst, which results in a sequence of -1, -1, -1, 1 for MIMO pilot signals in the HT-SIG field. *Id.* at 15–16 (citing Ex. 1004, 62–63; Ex. 1005, 94:21–25, 101:8–11, 110:20–21; Ex. 1036 ¶ 46). Thus, according to Petitioner, MIMO pilot signals and target pilot signals both have values of 1 and -1 in their signal point constellation. *Id.* at 16.

Patent Owner does not dispute Petitioner’s analysis for limitation 3.7. We are persuaded by Petitioner’s analysis in this section and above (*see supra* § II.D.3), and we find the combination of TGn-Sync, 802.11a, and Li teaches limitation 3.7.

Limitation 3.10 recites “wherein the transmitted burst signal is configured to suppress an increase in power consumption at a receiving apparatus even if the transmitted burst signal is not compatible with the receiving apparatus.” Mot. to Amend 12. As discussed above, we construe this limitation to only cover suppressing increases in power consumption in non-MIMO receivers. *See supra* § III.C. In addition, the “transmitted burst signal” signal is a MIMO burst. *See* Limitation 3.1; *see also* Pet. Opp. 5; Pet. Sur-reply 12; Ex. 1002 ¶ 230; Ex. 1036 ¶ 23. As such, Petitioner cites

Figure 40 of TGn-Sync for teaching limitation 3.10 and provides an annotated version of that figure, which is reproduced below.

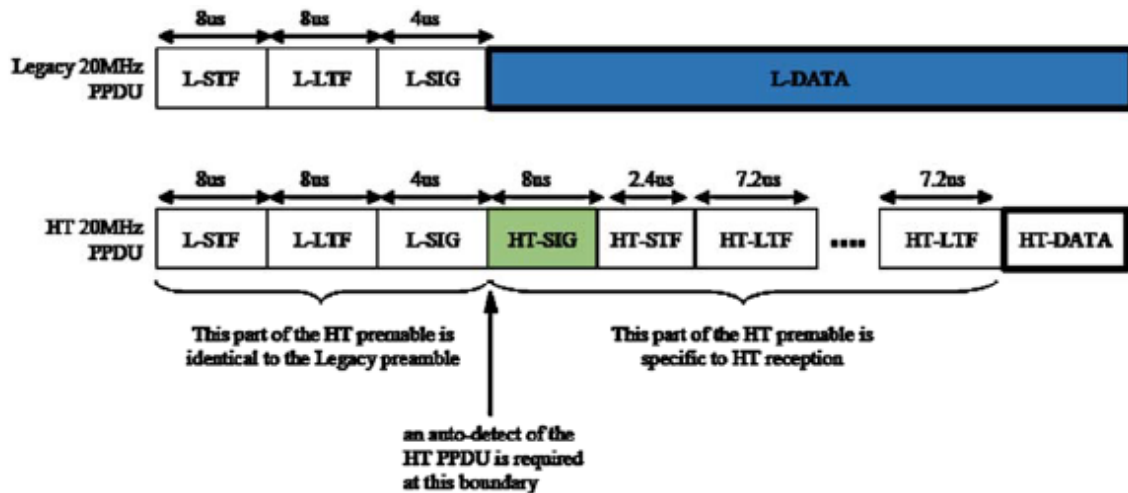


Figure 40: HT Preamble format

Pet. Opp. 20. TGn-Sync’s Figure 40 depicts a high throughput (HT) preamble format. Ex. 1003, 94. According to Petitioner, a non-MIMO legacy burst appears in the upper row and a MIMO HT burst appears in the lower row. Pet. Opp. 19. Petitioner highlights the HT-SIG field in green and contends this field allows a receiver to auto-detect a MIMO burst. *Id.* (citing, *inter alia*, Ex. 1003, 94; Ex. 1036 ¶ 53). Petitioner explains that “TGn-Sync’s MIMO burst . . . includes pilot signals in a data field that are different from pilot signals in the data field of a non-MIMO burst.” Pet. Sur-reply 7–8 (citing Pet. 52–54; Ex. 1002 ¶¶ 277–280; Ex. 1003, 120:14–15, 121:11–122:10, 123:2–10). As such, Petitioner contends a non-MIMO receiver “can use the HT-SIG field to detect and stop processing a MIMO burst and therefore reduce its power consumption.” *Id.* at 20 (citing Ex. 1036 ¶¶ 43–46, 53).

Petitioner further cites Li for teaching that “[b]ased on the structure of the MIMO burst, Li’s non-MIMO receiver detects the burst and ‘stop[s] its

operation.” Pet. Opp. 22 (quoting Ex. 1038, 4:49–53). Petitioner notes that Li “described a wireless LAN system with a MIMO burst format that is backwards compatible with a non-MIMO burst format, such as the one taught in 802.11a.” *Id.* (citing Ex. 1037, code (57), 1:22–25, 4:11–38, Figs. 5, 6). Relying on testimony from Dr. Wicker, Petitioner contends that stopping the operation of the receiver, as taught by Li, would have saved power. *Id.* (citing, *inter alia*, Ex. 1036 ¶¶ 56–57, 86).

Patent Owner argues that Petitioner’s obviousness contentions fail to address the second part of limitation 3.10: “even if the transmitted burst signal is not compatible with the receiving apparatus.” PO Reply 4–5. Patent Owner also argues “that a transmitted burst signal which may be configured to turn off the power consumption at a receiving apparatus is [not] the same as ‘suppressing an increase in power consumption’ as claimed.” *Id.* at 5.

We do not agree with Patent Owner’s arguments. Petitioner explains (*see* Pet. Opp. 5; Pet. Sur-reply 12) that the “transmitted burst signal” is a MIMO burst, which means that the non-compatible receiving apparatus must be a non-MIMO receiver. This is consistent with our construction of limitation 3.10 above. *See supra* § III.C. Petitioner’s unpatentability contentions in its Opposition directly address the second part of limitation 3.10 when discussing a non-MIMO receiver that receives a MIMO burst. *See* Pet. Opp. 19–22. In particular, Petitioner cites Li’s teaching about a SISO (i.e., non-MIMO) receiver “stop[ping] its operation whenever a MIMO transmission follows.” Ex. 1037, 4:49–53. Petitioner cites the same teaching from Li regarding “suppressing an increase in power consumption.” Pet. Opp. 22 (citing Ex. 1037, 4:49–53). Petitioner also puts

forth unrebutted testimony from Dr. Wicker establishing that stopping a receiver would result in power savings. Ex. 1036 ¶¶ 56–57, 86.

Thus, we are persuaded by Petitioner’s analysis, and we find the combination of TGn-Sync, 802.11a, and Li teaches limitation 3.10.

Petitioner relies on the same reasons for combining TGn-Sync and 802.11a as set forth in the Petition. *See* Pet. 19–24; Pet. Opp. 10–11 & n.2. We have discussed those reasons above. *See supra* § II.D.3. Petitioner further contends an ordinarily skilled artisan “would have applied Li’s technique in the combined system of TGn-Sync and 802.11a [because] TGn-Sync invites the combination.” Pet. Opp. 22. Petitioner explains that “detecting whether a burst is MIMO or non-MIMO . . . is the predicate step for stopping receiver operation and saving power as taught in Li.” *Id.* (citing Ex. 1003, 94:20–25, 101:6–12). Petitioner additionally contends that “[i]ncorporating Li’s technique also would have accomplished TGn-Sync’s power-saving objective.” *Id.* (citing Ex. 1003, 17:1–2, 17:21–24, 73:12–17, 91:1–4; Ex. 1036 ¶¶ 57, 86).

Patent Owner does not dispute Petitioner’s reasons for combining Li with TGn-Sync and 802.11a. Based on Petitioner’s analysis in this section and above (*see supra* § II.D.3), we are persuaded that an ordinarily skilled artisan would have had reasons to combine TGn-Sync, 802.11a, and Li.

Having considered Petitioner’s contentions and evidence and Patent Owner’s arguments, we find that the combination of TGn-Sync, 802.11a, and Li teaches every limitation of proposed substitute claim 3. Petitioner also has provided persuasive reasons why an ordinarily skilled artisan would have made its proposed combination. Thus, we determine Petitioner has shown, by a preponderance of the evidence, that the subject matter of

proposed substitute claim 3 would have been obvious over the combination of TGn-Sync, 802.11a, and Li.

3. *Proposed Substitute Claim 4*

Proposed substitute claim 4 is a method claim corresponding to proposed substitute claim 3. *Compare* Mot. to Amend 11–12, *with id.* at 13–14. Although proposed substitute claim 4 does not recite a generator or a transmitter, it recites corresponding generating and transmitting steps, as well as all other functions recited in proposed substitute claim 3. Petitioner relies on the same obviousness contentions for proposed substitute claim 4 as for proposed substitute claim 3. *See* Pet. Opp. 22. Patent Owner relies on the same arguments discussed above. *See* PO Reply 5–6.

For the same reasons discussed above with respect to proposed substitute claim 3 (*see supra* § III.E.2), we find that the combination of TGn-Sync, 802.11a, and Li teaches every limitation of proposed substitute claim 4. Petitioner also has provided persuasive reasons why an ordinarily skilled artisan would have made its proposed combination. Thus, we determine Petitioner has shown, by a preponderance of the evidence, that the subject matter of proposed substitute claim 4 would have been obvious over the combination of TGn-Sync, 802.11a, and Li.

F. *Patentability of Substitute Claims over Other Combinations*

Petitioner also contends the subject matter of proposed substitute claims 3 and 4 would have been obvious over the combination of TGn-Sync and 802.11a (without Li) and the combination of Sun, 802.11a, and Larsson. Pet. Opp. 10–30. Given that we have already found that proposed substitute

claims 3 and 4 would have been obvious over the combination of TGn-Sync, 802.11a, and Li, we need not reach these other combinations.

IV. CONCLUSION

Petitioner has shown, by a preponderance of the evidence, that claims 1 and 2 would have been obvious over (1) the combination of TGn-Sync and 802.11a and (2) the combination of Sun, 802.11a, and Larsson.

Regarding Patent Owner's motion to amend, Patent Owner has not shown written description support for the "first pilot signal" of proposed substitute claims 3 and 4 being in a MIMO data field. *See* 37 C.F.R. § 42.121(b). In addition, Petitioner has shown, by a preponderance of the evidence, that the subject matter of proposed substitute claims 3 and 4 would have been obvious over the combination of TGn-Sync, 802.11a, and Li. Thus, we *deny* Patent Owner's motion to amend.

ORDER

Accordingly, it is:

ORDERED that claims 1 and 2 of the '400 patent are held to be unpatentable;⁸

⁸ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this Decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent

FURTHER ORDERED that Patent Owner's motion to amend is *denied*; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to this proceeding seeking judicial review of our decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

In summary:

Claims	35 U.S.C. §	References/Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
1, 2	103(a)	TGn-Sync, 802.11a	1, 2	
1, 2	103(a)	Sun, 802.11a, Larsson	1, 2	
Overall Outcome			1, 2	

Motion to Amend Outcome	Claims
Original Claims Cancelled by Amendment	
Substitute Claims Proposed in the Amendment	3, 4
Substitute Claims: Motion to Amend Granted	
Substitute Claims: Motion to Amend Denied	3, 4
Substitute Claims: Not Reached	

Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

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