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Paper 19
Entered: March 12, 2018

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE, INC., HTC CORPORATION, HTC AMERICA, INC., MICROSOFT CORPORATION, MICROSOFT MOBILE OY, MICROSOFT MOBILE, INC., SAMSUNG ELECTRONICS CO., LTD., AND SAMSUNG ELECTRONICS AMERICA, INC., ZTE (USA) INC.,
Petitioners,

v.

EVOLVED WIRELESS LLC,
Patent Owner.

Cases IPR2016-00758, IPR2016-00981, IPR2016-01342, IPR2016-01349, IPR2017-00068, IPR2017-00106, IPR2017-00927[1]
Patent 8,218,481 B2

Before WILLIAM V. SAINDON, CHRISTOPHER L. CRUMBLEY, and TERRENCE W. McMILLIN, *Administrative Patent Judges*.

McMILLIN, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

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[1] IPR2016-01342 and IPR2016-01349 have been consolidated with IPR2016-00758. IPR2017-00068 and IPR2017-00106 have been joined with IPR2016-00758. IPR2016-00981 has been joined with IPR2016-01349. IPR2017-00927 has been joined with IPR2016-01342. Unless otherwise indicated, citations are to the record of IPR2016-00758, which is effectively, through the above-noted consolidations and joinders, the controlling case.

This is a Final Written Decision under 35 U.S.C. § 318(a) in IPR2016-00758, IPR2016-00981, IPR2016-01342, IPR2016-01349, IPR2017-00068, IPR2017-00106, and IPR2017-00927 as to the patentability of claims 1–4, 6, 8–11, 13, 15, and 16 of U.S. Patent No. 8,218,481 B2 ("the '481 patent") (Ex. 1001). We have jurisdiction under 35 U.S.C. § 6.

Based on the record before us, Petitioners have shown, by a preponderance of the evidence, that claims 1–4, 6, 8–11, 13, 15, and 16 are unpatentable.

I. BACKGROUND

A. Joinder and Consolidation

In IPR2016-00758, ZTE (USA) Inc., HTC Corporation, and HTC America, Inc., filed a Petition requesting an *inter partes* review of claims 1–4, 6, 8–11, and 13 of the '481 patent. Paper 2, 1. We instituted *inter partes* review on the following grounds of unpatentability: (1) whether claims 1, 2, 8, and 9 are unpatentable under 35 U.S.C. §§ 102(a) or (b)[2] as anticipated by Panasonic 792;[3] (2) whether claims 3 and 10 are unpatentable under 35 U.S.C. § 103(a) as having been obvious over Panasonic 792 and Panasonic 114;[4] and (3) whether claims 6 and 13 are unpatentable under 35 U.S.C.

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[2] The relevant sections of the Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112–29, 125 Stat. 284 (September 16, 2011), took effect on March 16, 2013. Because the application from which the '481 patent issued was filed before that date, our citations to Title 35 are to its pre-AIA version.
[3] Panasonic, Random Access Burst Evaluation In E-UTRA Uplink, 3 GPP Tdoc R1-060792, TSG-RAN WG1 Meeting #44bis, Athens, Greece (March 27–31, 2006) (Ex. 1002).
[4] Panasonic, Random Access Design For E-UTRA Uplink, 3GPP Tdoc R1-

§ 103(a) as having been obvious over Panasonic 792, Panasonic 114, and Chu.[5] Paper 12, 21.

In IPR2017-00068, Apple, Inc., Microsoft Corporation, Microsoft Mobile Oy, and Microsoft Mobile, Inc. (f/k/a Nokia Inc.) filed a Petition that "substantively copies the petition in co-pending IPR2016-00758" (IPR2017-00068, Paper 2, 1) and "includes only the grounds filed in IPR2016-00758 and is substantively identical on those grounds." IPR2017-00068 Paper 3, 1. Concurrently with the Petition, a Motion for Joinder with IPR2016-00758 was filed. IPR2017-00068 Paper 3. We instituted *inter partes* review in IPR2017-00068 and granted joinder of the parties in IPR2017-00068 to IPR2016-00758. Paper 27, 5.

In IPR2017-00106, Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc., filed a Petition that "substantively copies the petition in co-pending IPR2016-00758" (IPR2017-00106 Paper 1, 1) and "raises the same grounds of unpatentability for which the 758 Proceeding was instituted, challenges the same claims, and relies of the same prior art, arguments and evidence." IPR2017-00106 Paper 2, 1–2. Concurrently with its Petition, Samsung filed a Motion for Joinder with IPR2016-00758. IPR2017-00106 Paper 2. We instituted *inter partes* review in IPR2017-00106 and granted joinder of the parties in IPR2017-00106 to IPR2016-00758. Paper 28, 5.

061114, TSG-RAN WG1 Meeting #45, Shanghai, China (May 8–12, 2006) (Ex. 1003).

[5] David C. Chu, *Polyphase Codes With Good Periodic Correlation Properties*, IEEE Transactions on Information Theory 531–32 (July 1972) (Ex. 1004).

In IPR2016-01342, ZTE (USA) Inc., Samsung Electronics Co., Ltd., and Samsung Electronics America, Inc., filed a Petition requesting an *inter partes* review of claims 1–4, 6, 8–11, and 13 of the '481 patent. IPR2016-01342 Paper 2, 1. We instituted *inter partes* review on the following grounds of unpatentability: (1) whether claims 1 and 2 are unpatentable under 35 U.S.C. § 102(a) and (b) as anticipated by Panasonic 700;[6] (2) whether claim 3 is unpatentable under 35 U.S.C. § 103(a) as having been obvious over Panasonic 700 and Panasonic 114; (3) whether claims 4 and 6 are unpatentable under 35 U.S.C. § 103(a) as having been obvious over Panasonic 700, Panasonic 114, and Chu; (4) whether claims 8 and 9 are unpatentable under 35 U.S.C. § 103(a) as having been obvious over Panasonic 700 and Motorola 595;[7] (5) whether claim 10 is unpatentable under 35 U.S.C. § 103(a) as having been obvious over Panasonic 700, Panasonic 114, and Motorola 595; and (6) whether claims 11 and 13 are unpatentable under 35 U.S.C. § 103(a) as having been obvious over Panasonic 700, Panasonic 114, Chu, and Motorola 595. IPR2016-01342 Paper 11, 17–18.

In IPR2017-00927, Apple, Inc., Microsoft Corporation, Microsoft Mobile Oy, and Microsoft Mobile, Inc. (f/k/a Nokia Inc.) filed a Petition that "substantively copies the petition filed in co-pending IPR2016-01342" (IPR2017-00927, Paper 2, 1) and "includes only the grounds filed in IPR2016-01342 and is substantively identical on those grounds." IPR2017-

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[6] Panasonic, RACH preamble evaluation in E-UTRA uplink, TSG-RAN WG1 Meeting #44, Denver, USA (February 13–17, 2006) (Ex. 1035).
[7] US 2007/0058595 A1, (published March 15, 2007, filed March 20, 2006) (Ex. 1040).

00927 Paper 3, 1. Concurrently with the Petition, a Motion for Joinder with IPR2016-01342 was filed. IPR2017-00927 Paper 3. We instituted *inter partes* review in IPR2017-00927 and granted joinder of the parties in IPR2017-00927 to IPR2016-01342. IPR2017-00927 Paper 8, 5.

In IPR2016-00981, Apple, Inc., Microsoft Corporation, Microsoft Mobile OY, and Microsoft Mobile Inc. (f/k/a Nokia, Inc.) filed a Petition requesting an *inter partes* review of claims 1–4, 6, 8–11, 15, and 16 of the '481 patent. IPR2016-00981 Paper 2, 1. We instituted *inter partes* review on the following grounds of unpatentability: (1) whether claims 1 and 15 are unpatentable under 35 U.S.C. § 102(a) as anticipated by IEEE802.16-2004;[8] (2) whether claims 1 and 15 are unpatentable under 35 U.S.C. § 103(a) as having been obvious over IEEE802.16-2004 and IEEE802.16e-2005;[9] (3) whether claims 8 and 16 are unpatentable under 35 U.S.C. § 103(a) as having been obvious over IEEE802.16-2004 and Chou;[10] and (4) whether claims 8 and 16 are unpatentable under 35 U.S.C. § 103(a) as having been obvious over IEEE802.16-2004, IEEE802.16e-2005, and Chou. IPR2016-00981 Paper 10, 22.

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[8] IEEE Std 802.16-2004, "*IEEE Standard for Local and Metropolitan Area Networks Part 16: Air Interface for Fixed Broadband Wireless Access Systems*" (Oct. 1, 2004) (Ex. 1054).

[9] IEEE Std 802.16e-2005 and IEEE Std 802.16-2004/Cor1-2005, "*IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands and Corrigendum 1*" (Feb. 28, 2006) (Ex. 1057).

[10] US Patent No. 8,977,258 B2 (Ex. 1059).

In IPR2016-01349, ZTE (USA) Inc. filed a Petition requesting an *inter partes* review of claims 1–4, 6, 8–11, 13, 15, and 16 of the '481 patent. IPR2016-01349 Paper 2, 1. We instituted *inter partes* review on the following grounds of unpatentability: (1) whether claims 1 and 15 are unpatentable under 35 U.S.C. § 102(a) and (b) as having been anticipated by IEEE802.16-2004; (2) whether claims 1 and 15 are unpatentable under 35 U.S.C. § 103(a) as having been obvious over IEEE802.16-2004 and IEEE802.16e-2005; (3) whether claims 2–4 and 6 are unpatentable under 35 U.S.C. § 103(a) as having been obvious over IEEE802.16-2004 and Tan;[11] (4) whether claims 2–4 and 6 are unpatentable under 35 U.S.C. § 103(a) as having been obvious over IEEE802.16-2004, IEEE802.16e-2005, and Tan; (5) whether claims 8 and 16 are unpatentable under 35 U.S.C. § 103(a) as having been obvious over IEEE802.16-2004 and Chou; (6) whether claims 8 and 16 are unpatentable under 35 U.S.C. § 103(a) as having been obvious over IEEE802.16-2004, IEEE802.16e-2005, and Chou; (7) whether claims 9–11 and 13 are unpatentable under 35 U.S.C. § 103(a) as having been obvious over IEEE802.16-2004, Chou, and Tan; and (8) whether claims 9–11 and 13 are unpatentable under 35 U.S.C. § 103(a) as having been obvious over IEEE802.16-2004, IEEE802.16e-2005, Chou, and Tan. IPR2016-01349 Paper 11, 26.

ZTE filed a Motion for Joinder of IPR2016-01349 with IPR2016-00981. IPR2016-01349 Paper 8. We granted joinder of the parties in IPR2016-00981 to IPR2016-01349. IPR2017-01349 Paper 14, 6.

[11] US Patent No. 8,000,305 B2 (Ex. 1074).

Pursuant to agreement of the parties, and in order to more efficiently resolve the pending proceedings relating to the ’481 patent, we consolidated IPR2016-00758, IPR2016-01342, and IPR2016-01349. Paper 24, 3. After joinder and consolidation, we ordered the Petitioners to file each paper as a single, consolidated filing. *Id.* at 5. As a result, there was a single, consolidated reply filed on behalf of all the Petitioners. Paper 38 (Petitioners’ Reply to Patent Owner’s Response (“Pet. Reply”)). And, because there is only one Patent Owner and these proceedings have been joined and consolidated, there was, of course, only one response in these proceedings. Paper 34 (Patent Owner’s Response (“PO Resp.”)).

The Board held a consolidated oral hearing on October 17, 2017. The various Petitioners designated counsel to present consolidated argument on behalf of all Petitioners on all grounds of unpatentability, and the transcript of the hearing has been entered into the record. Paper 47 (Transcript of Oral Argument (“Tr.”)).

B. Instituted Grounds of Unpatentability

The instituted trial grounds of unpatentability are:

Ground	**Reference(s)**	**Basis**	**Challenged Claims**
1	Panasonic 792	§ 102	1, 2, 8, and 9
2	Panasonic 792 and Panasonic 114	§ 103	3 and 10
3	Panasonic 792, Panasonic 114, and Chu	§ 103	6 and 13
4	Panasonic 700	§ 103	1 and 2
5	Panasonic 700 and Panasonic 114	§ 103	3
6	Panasonic 700, Panasonic 114, and Chu	§ 103	4 and 6
7	Panasonic 700 and Motorola 595	§ 103	8 and 9

Ground	Reference(s)	Basis	Challenged Claims
8	Panasonic 700, Panasonic 114, and Motorola 595	§ 103	10
9	Panasonic 700, Panasonic 114, Chu, and Motorola 595	§ 103	11 and 13
10	IEEE802.16-2004	§ 102	1 and 15
11	IEEE802.16-2004 and IEEE802.16e-2005	§ 103	1 and 15
12	IEEE802.16-2004 and Tan	§ 103	2–4 and 6
13	IEEE802.16-2004, IEEE802.16e-2005 and Tan	§ 103	2–4 and 6
14	IEEE802.16-2004 and Chou	§ 103	8 and 16
15	IEEE802.16-2004, IEEE802.16e-2005 and Chou	§ 103	8 and 16
16	IEEE802.16-2004, Chou, and Tan	§ 103	9–11 and 13
17	IEEE802.16-2004, IEEE802.16e-2005, Chou, and Tan	§ 103	9–11 and 13

C. The ’481 Patent

The ’481 patent is titled, “Method of Transmitting Data in a Mobile Communication System.” Ex. 1001 (54). It issued on July 10, 2012, from U.S. Patent Application No. 12/303,947, filed on June 8, 2007, which claims priority from KR 10-2006-0052167, filed June 9, 2006, and KR 10-2006-0057488, filed June 26, 2006. *Id*. at (21), (22), (30), (45). According to the Specification, “[t]he present invention relates to a mobile communication system, and more particularly, to a method of expanding a code sequence, a structure of a random access channel and method of transmitting data in a mobile communication system.” *Id.* at 1:16–20. The disclosed methods and

systems are alleged to increase the amount of data which can be transmitted to make the data transmission more robust and less susceptible to noise or channel change. *Id*. at 2:45–49. And, the invention is alleged to be applicable to wireless Internet systems. *Id.* at 18:28–30.

The ’481 patent contains 16 claims which are directed to the structure of a preamble sequence of a data transmission. *Id*. at 18:33–20:16. Independent claim 1 is directed to “[a] method of transmitting a preamble sequence” and independent claim 8 is directed to “[a] transmitter for transmitting a preamble sequence.” *Id.* at 18:33–42, 18:60–19:3. The independent claims require “repeating a specific sequence, having a length (L), N times to generate a consecutive sequence having a length (N*L)” and “concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence.” *Id.* Figure 11, which illustrates the claimed preamble structure with a single prefix and a repeated sequence, is reproduced below.

FIG. 11

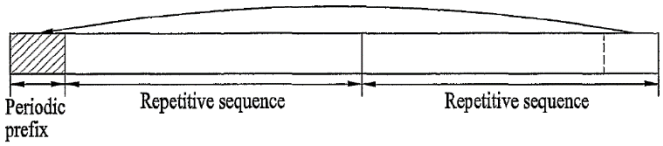

Figure 11 depicts a single prefix at the front end of consecutive, repeated sequences. *Id.* at 11:55–64.

Claims 1 and 8 of the ’481 patent are independent. Claim 1 recites:

> 1. A method of transmitting a preamble sequence in a mobile communication system, the method comprising:
>
> repeating a specific sequence, having a length (L), N times to generate a consecutive sequence having a length (N*L);

> generating said preamble sequence by concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence; and
>
> transmitting, on a random access channel, said preamble sequence to a receiving side.

Ex. 1001, 18:33–42.

Claim 8 recites:

> 8. A transmitter for transmitting a preamble sequence in a mobile communication system, the transmitter comprising:
>
> a preamble generation unit configured to generate said preamble sequence by repeating a specific sequence, having a length (L), N times to generate a consecutive sequence having a length (N*L) and concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence;
>
> a transmission unit configured to transmit, on a random access channel, said preamble sequence to a receiving side.

Ex. 1001, 18:60–19:3.

Dependent claims 2 and 9 recite generating "said specific sequence from a Constant Amplitude Zero Auto Correlation (CAZAC) sequence." *Id.* at 18:43–45, 19:4–7.

Dependent claims 3 and 10 recite applying "a cyclic shift sequence to said specific sequence generated from said CAZAC sequence." *Id.* at 18:46–48, 19:8–11.

Dependent claims 4 and 11 recite "a value of said applied cyclic shift is determined as an integer multiple of a predetermined circular shift unit." *Id.* at 18:49–51, 19:13–15.

Dependent claims 6 and 13 recite "multiplying said specific sequence by an exponential sequence." *Id.* at 18:54–56, 20:1–4.

Dependent claims 15 and 16 recite "said consecutive sequence comprises at least a first sequence, a second sequence, and an N-th sequence; and said CP is identical to the rear part of said N-th sequence." *Id.* at 20:9–16.

D. Cited References

The earliest priority date claimed for the '481 patent is June 9, 2006. Ex. 1001, (30), 1:7–12. Panasonic 792 (Ex. 1002) "is a submission from Panasonic . . . for discussion at a meeting [of a Third Generation Partnership Project[12] working group] on March 27-31, 2006." PO Resp. 14. "Panasonic 114 [Ex. 1003] is another submission from Panasonic . . . for discussion at a May 8-12, 2006 meeting." *Id.* at 16. "Panasonic 700 [Ex. 1035] is simply an earlier Panasonic submission, for a February 2006 meeting." *Id.* at 15. Chu (Ex. 1004) is a publication "from July 1972 IEEE Transactions on Information Theory." *Id.* at 19. Motorola 595 (Ex. 1040) is a published US patent application filed on March 20, 2006. Ex. 1040, (22). "IEEE802.16-2004 [Ex. 1054] is a standard published in 2004 by IEEE." PO Resp. 20. "IEEE802.16E-2005 [Ex. 1057] is an amendment to the IEEE 802.16 standard published in 2005." *Id.* at 21. Tan (Ex. 1074) is a US patent which claims priority to a provisional application filed on January 17, 2006. Ex. 1074, (60). Chou (Ex. 1059) is a US patent which issued on an application

[12] The Third Generation Partnership Project ("3GPP") was the standard setting organization that developed the Long Term Evolution ("LTE") standard, sometimes referred to as 4G. PO Resp. 1, 7.

filed September 9, 2005. Ex. 1059, (22). Patent Owner does not challenge the prior art status of any cited reference. *See generally* PO Resp. We find that the cited references are prior art under 35 U.S.C. §§ 102 and 103.

1. Panasonic 792 (Ex. 1002)

Panasonic 792 is a titled, "Random Access Burst Evaluation In E-UTRA Uplink." Ex. 1002, 1. Panasonic 792 discloses a random access channel (RACH) preamble structure. Ex. 1002 at 2. Paragraph 2.2 of Panasonic 792 discloses a preamble structure which consists of a cyclic prefix (CP) and a repeated CAZAC sequence. *Id*. Figure 1 of Panasonic 792 is reproduced below.

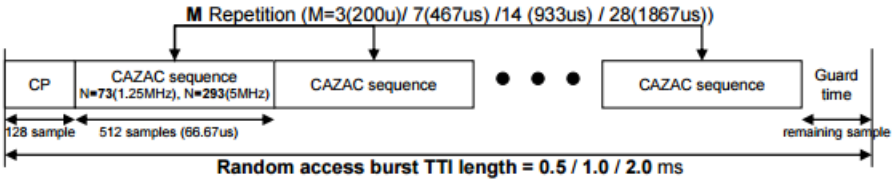

Figure 1 – preamble structure

Figure 1 of Panasonic 792 depicts a "preamble structure" with a cyclic prefix (CP) and "M-times repetition of N=73 (1.25 MHz) or N=293 (5 MHz) CAZAC sequence." *Id*. Panasonic 792 discloses the preamble as constituting, or as part of, a "random access burst," and further discloses transmitting the preamble. *Id*. at 5. Figure 6 of Panasonic 792 is reproduced below.

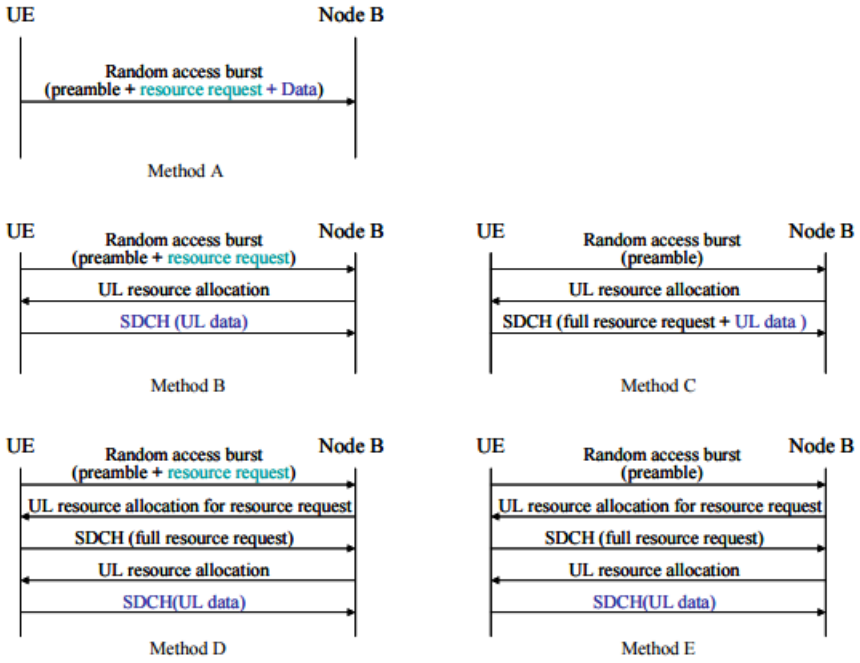

Figure 6 Initial resource allocation sequence

Figure 6 of Panasonic 792 depicts transmission of a "random access burst" comprising the preamble from UE (user equipment) to Node B as part of five transmission methods. *Id*. at 5. Each of these five transmission methods is described in paragraph 2.3 of Panasonic 792. *Id*. at 5–6.

2. Panasonic 700 (Ex. 1035)

Panasonic 700 is titled "RACH preamble evaluation in E-UTRA uplink." Ex. 1002, 1. Panasonic 700 discloses a random access channel (RACH) preamble structure. Ex. 1002 at 2. Panasonic 700 states, "[a] preamble sequence should have good auto-correlation and good-cross correlation [sic]. General chirp-like (GCL) has been considered to satisfy these requirements. In our preamble performance evaluation, Zadoff-Chu sequence, a special case of GCL, is used." *Id.* (citations omitted). Figure 1 of Panasonic 700 is reproduced below.

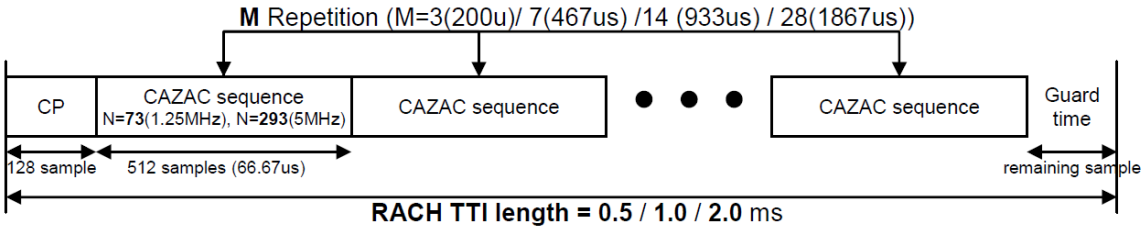

Figure 1 – RACH preamble structure

Figure 1 of Panasonic 700 depicts a "preamble structure" with a cyclic prefix (CP) and "M-times repetition of N=73 (1.25 MHz) or N=293 (5 MHz) CAZAC sequence." *Id*. Panasonic 700 discloses use of a "[r]epetition factor (M) of CAZAC sequence" of 3, 7, 14, and 28. *Id*.

3. Panasonic 114 (Ex. 1003)

Panasonic 114 is titled, "Random Access Design For E-UTRA Uplink." Ex. 1003, 1. Panasonic 114 is directed to comparing performance of different types of preamble sequences including cyclic-shifted CAZAC sequences. Ex. 1003, 1. Panasonic 114 discloses, "cyclic-shifted CAZAC sequence has superior performance" and "[a]s the results [sic], we propose to choose cyclic-shifted Zadoff-Chu CAZAC as preamble sequence mainly." *Id*. at 2.

4. Chu (Ex. 1004)

Chu is a paper titled, "Polyphase Codes With Good Correlation Properties." Ex. 1004, 1. According to Petitioners, "Chu discloses and introduces the sequence that is now known as the Zadoff-Chu sequence." Paper 2, 14; Ex. 1014 ¶ 52. Chu describes the construction of complex codes and discloses a number of mathematical equations. Ex. 1004, 1–2. The purpose is to construct codes with good autocorrelation properties. *Id*. at 1. Chu teaches the use of "[t]rivial variations such as cyclic shifts" and

"linear phase shifts of the form exp $i(2\pi qk/N)$, where q is any integer." *Id*. at 2.

5. Motorola 595 (Ex. 1040)

Motorola 595 is titled, "Method and Apparatus for Reducing Round Trip Latency and Overhead Within a Communication System." Ex. 1040, (54). Motorola 595 relates to "wireless broadband system development, such as in the 3rd generation partnership project (3GPP) Long Term Evolution (LTE)." *Id*. ¶ 3.

Motorola 595 discloses circuitry for a base station or mobile station to perform uplink and downlink transmission. *Id*. ¶ 41. Figure 2 of Motorola 595 is reproduced below.

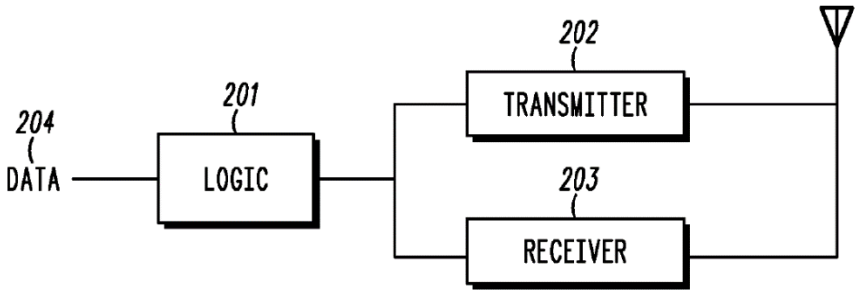

FIG. 2

200

Figure 2 of Motorola 595 depicts circuitry 200 comprising logic circuitry 201, a microprocessor controller, transmit circuitry 202, and receive circuitry 203. *Id*. ¶ 41. Motorola 595 states, "transmitter 202 and receiver 203 are preferably well known transmitters and receivers that utilize a 3GPP network protocol." *Id*.

6. IEEE802.16-2004 (Ex. 1054)

IEEE802.16-2004 is an Institute of Electrical and Electronics Engineers (IEEE) Standard for local and metropolitan area networks titled "Part 16: Air Interface for Fixed Broadband Wireless Access Systems." Ex. 1054, 1. IEEE802.16-2004 discloses a "long preamble" that:

> [C]onsists of two consecutive OFDM symbols. The first OFDM symbol uses only subcarriers the indices of which are multiples of 4. As a result, the time domain waveform of the first symbol consists of four repetitions of 64-sample fragment, preceded by a CP. The second OFDM symbol utilizes only even subscribers, resulting in time domain structure composed of two repetitions of a 128-sample fragment, preceded by a CP.

Id. at 483. Figure 205 of IEEE802.16-2004 is reproduced below.

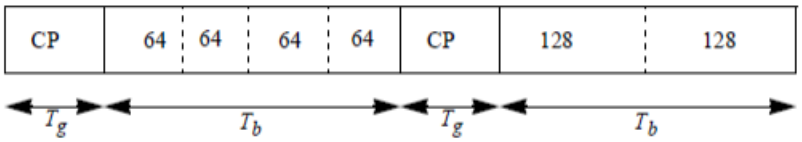

Figure 205—Downlink and network entry preamble structure

Figure 205 of IEEE802.16-2004 depicts a "long preamble" structure including a single cyclic prefix preceding four 64 sample fragments and a single cyclic prefix preceding two 128 sample fragments.

7. IEEE802.16E-2005 (Ex. 1057)

IEEE802.16e-2005 is an Institute of Electrical and Electronics Engineers (IEEE) Standard for local and metropolitan area networks titled "Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands and Corrigendum 1." Ex. 1057, 1. IEEE802.16e-2005 "updates and expands IEEE Std 802.16-2004 to allow for mobile subscriber stations." *Id.* at 4.

8. Tan (Ex. 1074)

Tan is titled, "Preamble Sequencing for Random Access Channel in a Communication System." Ex. 1074, (54). Tan is directed to "[a] system and method for initializing a system communication without previous reservations for random access channel (RACH) access." *Id*. at (57) (Abstract). Tan teaches that, "[w]ith proper configuration of the preamble sequence, the amount of interference generated can be minimized." *Id*. at 3:17–19.

Tan teaches the use of "cyclically shifted versions of the signature sequences" and that "the signature sequences are obtained from a constant amplitude zero autocorrelation (CAZAC) sequence, which include different "classes" of generalized chirp like (GCL) or Chu-sequences." *Id*. at 3:35–36, 55–58. Chu sequences are complex quadratic sequences "with low cross correlation at all time lags which improves the detection performance." *Id*. at 3:59–61, 4:37–64. Tan states that its teachings are applicable to "systems including 3GGP, 3GPP2, and 802.16 communication systems." *Id*. at 8:17–18.

9. Chou (Ex. 1059)

Chou is titled "System and Method for Communicating with Fixed and Mobile Subscriber Stations in Broadband Wireless Access Networks." Ex. 1059, (54). Chou relates to wireless networks and wireless communications. *Id.* at 1:9–10. Figure 1 of Chou is reproduced below.

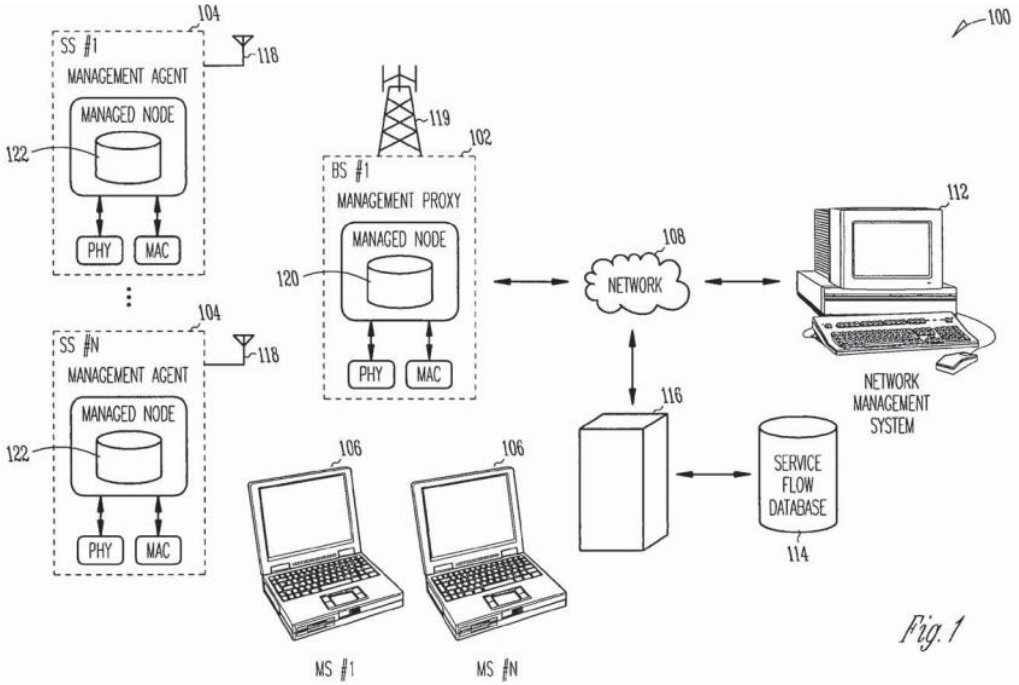

Figure 1 depicts a broadband wireless access (BWA) network. *Id*. at 2:3–14. Chou provides this description of Figure 1:

> Broadband wireless network 100 includes base station (BS) 102 which may communicate with one or more fixed subscriber stations (SS) 104 and one or more mobile subscriber stations (MS) 106. Base station 102 may be coupled through network 108 to network management system (NMS) 112, servers 116 and database 114.

Id. at 2:5–10. Chou states, "[n]etwork 100 may be based on the IEEE 802.16-2004 standard and/or IEEE 802.16(e) proposed specification" and the base stations may communicate with the subscriber stations and mobile subscriber stations on physical layer (PHY) configurations using "a SS based on IEEE 802.16-2004." *Id*. at 2:15–16, 5:38–41. Chuo also provides, "the downlink PHY data units transmitted by the base station may begin with a long preamble." *Id*. at 6:29–30.

II. ANALYSIS

A. Patent Owner Does Not Argue Claims 1, 2, 8, 9, 15, and 16

"Patent Owner is no longer contesting the validity of claims 1-2, 8-9, and 15-16 and therefore addresses only grounds 2-3, 5-6, 8-9, 12-13 and 16-17 and only with respect to claims 3-4, 6, 10-11, and 13." PO Resp. 4. Patent Owner's position was discussed during the following exchange at oral argument:

> MR. FINN: Good afternoon, Your Honors. As I said, my name is Miles Finn and I represent Evolved Wireless here today.
>
> JUDGE MCMILLIN: Mr. Finn, a preliminary question, your response at page 4 says Patent Owner is no longer contesting the validity of claims 1, 2, 8, 9 and 15 and 16. Are you conceding the unpatentability of the claims?
>
> MR. FINN: No, Your Honor. We are saying that the – we are not contesting it. You, of course, have to find the Patent Owner make a prima facie case of invalidity.
>
> JUDGE CRUMBLEY: But you are not contesting it?
>
> MR. FINN: That's correct.

Tr. 19:14–24. Thus, Patent Owner has explicitly declined to challenge Petitioners' arguments and evidence related to the unpatentability of claims 1, 2, 8, 9, 15, and 16 of the '481 patent. Patent Owner was repeatedly warned in the scheduling orders entered in these proceedings that "any arguments for patentability not raised in the response will be deemed waived." Paper 13, 2; Paper 25, 3; IPR2016-01342 Paper 12, 3; IPR2016-01349 Paper 12, 3. As a result, Patent Owner has waived any argument that Petitioners have not shown that claims 1, 2, 8, 9, 15, and 16 are unpatentable. *In re NuVasive*, 842 F. 3d 1376, 1380–1381 (Fed. Cir.

2016).[13] However, as noted below, it is Petitioners' burden to show why the challenged claims are unpatentable and this burden never shifts to Patent Owner.

In addition, Patent Owner did not file any expert or other evidentiary declarations.[14] In contrast, Petitioners presented 79 exhibits (*see* Paper 46 (Petitioners' Exhibit List)) including 3 expert declarations (2 Declarations of Paul S. Min, Ph.D (Ex. 1014 (in support of 758 Pet. [15]); Ex. 1036 (in support of 1342 Pet.) and the Declaration of Jonathan Wells (Ex. 1052 (in support of 1349 Pet.)) to which we give appropriate evidentiary weight in light of the cross-examination testimony submitted by Patent Owner. In our consideration of the record in these proceedings, we keep in mind that attorney argument is not evidence and Patent Owner cannot rebut evidence with unsworn attorney argument. *See Gemtron Corp. v. Saint-Gobain Corp.*, 572 F. 3d 1371, 1380 (Fed. Cir. 2009) ("[U]nsworn attorney argument . . . is not evidence and cannot rebut . . . evidence.").

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[13] Because Patent Owner no longer contests the Petitioners' showing relating to the unpatentability of claims 1, 2, 8, 9, 15, and 16, Petitioners did not address these claims and the related grounds in the Petitioners' Reply to Patent Owner's Response. *See generally* Pet. Reply.

[14] Patent Owner filed 3 exhibits: US Patent Appl. No. 11/332,531 (Jung) (Ex. 2001); Transcript of the Deposition of Dr. Jonathan Wells (Petitioners' expert) (Ex. 2002); and Patent Owner's Demonstrative Exhibits (Ex. 2003).

[15] We use the term "758 Pet." to refer to the Petition (Paper 2) in IPR2016-00758. In a like manner, we shall use "1342 Pet." to refer to the Petition (Paper 2) in IPR2016-01342 and "1349 Pet." to refer to the Petition (Paper 2) in IPR2016-01349.

B. Claim Construction

A claim of an unexpired patent subject to *inter partes* review receives the "broadest reasonable construction in light of the specification of the patent in which it appears." 37 C.F.R. § 42.100(b); *see also Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). We shall construe only terms that are in controversy and then only to the extent necessary to resolve the controversy. *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

The parties' dispute requires resolution of only one claim construction issue. Patent Owner argues:

> Grounds 12–13 and 16–17 rely upon IEEE802.16-2004 as allegedly disclosing the claimed preamble structure of the '481 patent. The structure disclosed in IEEE802.16-2004 includes multiple cyclic prefixes, however, and therefore fails to disclose the limitation "concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence" ***under the proper construction***.

PO Resp. 32 (emphasis added)).[16]

With regard to claim construction, Patent Owner argues:

> The arguments advanced in the 1349 Petition, however, require that a claim phrase for which Petitioners did not offer a construction be addressed in this Patent Owner Response. Specifically, the phrase "generating said preamble sequence by concatenating a single cyclic prefix to a front end of said consecutive sequence" places two limitations on the claimed structure which the Board should apply in evaluating the

[16] In view of limiting its arguments to claims 3, 4, 6, 10, 11, and 13, Patent Owner states, "[t]he claim construction discussions in the petitions are therefore not relevant." PO Resp. 24.

> instituted grounds that rely upon IEEE802.16-2004 as a reference.
>
> First, the claimed preamble sequence can only include one cyclic prefix. This follows from the plain language, which requires "concatenating a single cyclic prefix." If more than one cyclic prefix is concatenated to the consecutive sequence, this limitation is not met.
>
> . . . .
>
> Second, the claimed preamble sequence must only have a cyclic prefix at the beginning of the preamble sequence. This too, follows from the plain language which states that the single cyclic prefix is concatenated "***to a front end*** of said consecutive sequence."

PO Resp. 24–26. Patent Owner's argument that its construction is supported by the "plain language" of this phrase was contradicted at oral argument. Patent Owner's counsel argued, "does the claim prohibit somebody from adding the second CP to a preamble sequence? Well, no, not literally." Tr. 21:14–15.

Patent Owner's claim construction is difficult to reconcile with its failure to contest the patentability of claims 1 and 8 and grounds 10, 11, 14, and 15. Patent Owner's argument regarding claim construction is in accordance with its argument that IEEE802.16-2004 does not disclose or teach "concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence." *See* PO Resp. 44–47. But pursuant to uncontested Ground 10, claim 1 is challenged as anticipated by IEEE802.16-2004. And pursuant to uncontested Grounds 11, 14, and 15, claims 1 and 8 are challenged as obvious and Petitioners rely on IEEE802.16-2004 as teaching "concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence." *See* 1349 Pet., 36, 59–60, 62. Thus, Patent Owner does not contend that IEEE802.16-2004 does not teach all elements of the

"concatenating" limitation or contest the Board reaching the conclusion that claims 1 and 8 are anticipated and obvious. This conclusion is inconsistent with Patent Owner's claim construction position. Moreover, Patent Owner does not contest Panasonic 792 and Panasonic 700 disclose "concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence." *See generally* PO Resp. Claim 1, containing this limitation, is challenged as anticipated by Panasonic 792 pursuant to Ground 1, and claim 1 is challenged as anticipated by Panasonic 700 pursuant to Ground 4. And, Patent Owner is not contesting the patentability of claim 1 or Grounds 1 and 4. As Patent Owner apparently recognizes by not contesting the unpatentability of claims 1 and 8 containing the "concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence" limitation on any of these asserted grounds, even if we were to construe the claims as proposed by Patent Owner, this would not be inconsistent with finding the cited art discloses this limitation or concluding claims 1 and 8 are unpatentable.[17]

We do not agree that the "plain language" of the phrase, "concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence" in the context of independent claims 1 and 8 supports limiting the claimed preamble sequence to: (1) include only one cyclic prefix; and to (2) only have a cyclic prefix at the beginning of the preamble sequence. Claims 1 and 8 recite, "repeating a specific sequence, having a length (L), N times

[17] At the oral argument, Patent Owner's counsel said, "Now we move on to the Panasonic references. After all of our claim construction, claim construction doesn't matter here." Tr. 29:16–17.

to generate a consecutive sequence having a length (N*L)" and generating a preamble sequence by "concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence." Ex. 1001, 18:35–40, 18:62–67. Claims 1 and 8 further recite transmitting, "said preamble sequence." The plain language of claims 1 and 8 requires generating a preamble sequence by concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence, which is a sequence generated by repeating a specific sequence, and then transmitting that generated preamble sequence. As long as those requirements are met, the plain meaning of this claim language is met under its broadest reasonable construction. We agree with Petitioners that "the term 'single' is given its full weight with respect to the 'consecutive sequence' by limiting the number of CPs concatenated to the front end of the 'consecutive sequence' to one." Pet. Reply 6–7.

Claim 1 is directed to a "method comprising" three recited steps. "Comprising" is an inclusive or open-ended transitional term and does not exclude additional, unrecited, method steps or apparatus elements. *Invitrogen Corp. v. Biocrest Mfg., L.P.*, 327 F.3d 1364, 1368 (Fed. Cir. 2003) ("The transition 'comprising' in a method claim indicates that the claim is open-ended and allows for additional steps."); *Genentech, Inc. v. Chiron Corp.*, 112 F.3d 495, 501 (Fed. Cir. 1997) ("'Comprising' is a term of art used in claim language which means that the named elements are essential, but other elements may be added and still form a construct within the scope of the claim."). Claim 1 is, thus, open-ended; the method requires that the three expressly recited steps be performed, but the method is not limited to those three steps.

Claim 1 recites "repeating a specific sequence, having a length (L), N times to generate a consecutive sequence having a length (N*L)" and "generating said preamble sequence by concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence." The wording of this method claim does not support limiting the claim to the construction Patent Owner argues. To the contrary, although the claim requires "by concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence," this method claim does not preclude additional steps such as repeating this step and concatenating another cyclic prefix to the front end of another consecutive sequence. Similar reasoning applies to claim 8. The transmitter must contain a preamble generation unit as required by the claim, but the claim does not preclude additional components that may generate additional sequences.

As noted above, the claims of an unexpired patent subject to *inter partes* review receive the "broadest reasonable construction ***in light of the specification*** of the patent in which it appears." 37 C.F.R. § 42.100(b) (emphasis added). Patent Owner does not cite to the Specification to support its proposed construction. *See* PO Resp. 23–31 ("Claim Construction"). In the "Remarks" accompanying the claim amendments in which the "concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence" limitation was added to the claims, the Applicants did not cite to the Specification to support the amendments. Ex. 1005, 544. During the following exchange at oral argument, Patent Owner's counsel did not

identify any portion of the Specification that supported its proposed claim construction.

> JUDGE CRUMBLEY: Counsel, I want to let you get to this, I didn't see anything in your papers about – you rely on the language of the claims and you rely on the prosecution history, the amendment and the prosecution history. I didn't see anything specifically in your papers about the specification, that there's some particular usage in the specification that limits it to a single CP. Am I missing something or are you just relying on the language in the prosecution history?
>
> MR. FINN: We are relying on what I have just said.

Tr. 29:18–25. Thus, Patent Owner makes no argument that the Specification supports its proposed claim construction.

Patent Owner, instead, relies on argument submitted during prosecution to distinguish a cited reference, Jung, to support its proposed claim construction. PO Resp. 24–27. Specifically, Patent Owner relies on "Remarks" submitted during prosecution (*see* PO Resp. 25 (citing Ex. 1005, 545–46)) and an annotated Fig. 2 submitted during prosecution (*see id.* at 26 (citing Ex. 1005, 546)). Annotated Figure 2 of Jung as submitted during prosecution is reproduced below (*id.*).

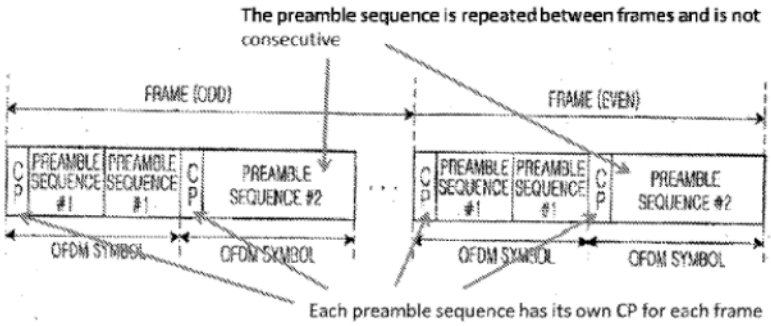

FIG.2

Figure 2 of Jung depicts a preamble structure in a mobile communication system. Ex. 2001 ¶ 29. Although Figure 2 of Jung appears to show "Preamble Sequence #1" is repeated and, thus, to show a "consecutive sequence," Applicants argued it did not:

> Furthermore, FIG. 2 of Jung arguably illustrates a consecutive "preamble sequence #1." However, Applicant submits that the consecutive "preamble sequence #1," as illustrated in FIG. 2 of Jung is entirely different from the "consecutive sequence" required in independent claim 31 [corresponding to issued claim 1 (*see* Ex. 1005, 541)]. Specifically, paragraph 0041 of Jung discloses that "the preamble sequence transmitted through the first transit antenna is referred to as the first preamble sequence (Preamble Sequence #1)." Additionally, paragraphs 0046-0051 of Jung disclose that the first preamble sequence is divided into subsequences and the generated subsequences are transmitted through the first antenna. Accordingly, Applicant submits that in view of paragraphs 0041 and 0046-0051 of Jung, the "preamble sequence #1" of FIG. 2 of Jung is a consecutive sequence of subsequences of the first preamble sequence. ***In other words, Jung does not repeat the first preamble sequence in order to create a consecutive sequence, and therefore, the consecutive "preamble sequence #1" illustrated in FIG. 2 of Jung, is patentably distinguishable from the "consecutive sequence" of independent claim [1].*** Thus, notwithstanding the arguments presented above, Applicant submits that Jung cannot teach or suggest "repeating a specific

> sequence, having a length (L), N times to generate a consecutive sequence having a length (N*L),” as recited in independent claim [1].

Ex. 1005, 546–547 (emphasis added). The main thrust of Applicants' argument throughout these “Remarks” was that Jung did not disclose a “consecutive sequence.” *See* Ex. 1005, 544–547. Applicants argued:

> [S]ince the second preamble sequence of Jung repeated in different frames, the second preamble sequence of Jung is not a consecutive sequence as required by independent claim [1].
>
> . . . .
>
> Similar to the arguments presented above with regard to cited paragraph 0064 of Jung, Applicant submits that although paragraph 0068 of Jung arguable discloses and inserting OFDM symbols into an effective OFDM symbol, paragraph 0068 of Jung fails to disclose generating a consecutive sequence by repeating a specific sequence, as required by independent claim [1].
>
> . . . .
>
> As illustrated in annotated FIG. 2 of Jung, the preamble sequences do not form a consecutive sequence, rather the preamble sequences are repeated in different frames.

Ex. 1005, 545–46. The Examiner did not explain why the claims were considered allowable or which, if any, of Applicants' arguments was found to be persuasive. Ex. 1005, 696. Under these circumstances, we do not find Applicants' arguments during prosecution to be sufficiently clear and unmistakable to overcome the plain meaning of the claims or to support a broadest reasonable construction that is limited in the manner argued by

Patent Owner. *See Omega Eng'g, Inc. v. Raytek Corp.*, 334 F. 3d 1314, 1326 (Fed. Cir. 2003) ("our precedent requires that the alleged disavowing actions or statements made during prosecution be both clear and unmistakable").

C. Claim-by-Claim Analysis

To prevail on its challenges, Petitioners must demonstrate by a preponderance of the evidence that the claims are unpatentable. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d). "In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable." *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify "with particularity . . . the evidence that supports the grounds for the challenge to each claim")). This burden never shifts to Patent Owner. *See Dynamic Drinkware, LLC. v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (citing *Tech. Licensing Corp. v. Videotek, Inc.*, 545 F.3d 1316, 1326–27 (Fed. Cir. 2008)) (discussing the burden of proof in *inter partes* review).

To anticipate a claim under 35 U.S.C. § 102, a prior art reference must disclose every limitation of the claimed invention and must describe the applicant's claimed invention sufficiently to have placed a person of ordinary skill in the field of the invention in possession of it. *In re Schreiber*, 128 F.3d 1473, 1477 (Fed. Cir. 1997); *In re Spada*, 911 F.2d 705, 708 (Fed. Cir. 1990).

A claim is unpatentable as obvious under 35 U.S.C. § 103 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." *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) objective evidence of non-obviousness, i.e., secondary considerations.[18] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

Additionally, the obviousness inquiry typically requires an analysis of "whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (requiring "articulated reasoning with some rational underpinning to support the legal conclusion of obviousness")); *see In re Warsaw Orthopedic, Inc.*, 832 F.3d 1327, 1333 (Fed. Cir. 2016) (citing *DyStar Textilfarben GmbH & Co. Deutschland KG v. C. H. Patrick Co.*, 464 F.3d 1356, 1360 (Fed. Cir. 2006)).

With regard to the level of ordinary skill in the art, Petitioners argue that:

> The person of ordinary skill in the art of the subject matter of the 481 patent would have had a master's degree in electrical engineering with 2-3 years of experience in cellular communication systems, and would have been aware of the efforts of the Third Generation partnership Project ("3GPP") and its various groups. (Ex. 1014, Min. Decl., at ¶ 34.) Alternatively,

[18] The parties do not address secondary considerations, which, accordingly, do not form part of our analysis.

> that person would have had a Ph.D. in electrical engineering with the same familiarity with the work of the 3GPP and its various groups. (*Id.*)

758 Pet. 5–6; 1342 Pet. 5. Patent Owner does not make any argument or present any evidence with regard to the level of ordinary skill in the art or contest any part of Petitioners' showing. *See generally* PO Resp. We find Petitioners' proposal reasonable, and accordingly, based on this record, we adopt the level of skill in the art proposed by Petitioners.

1. Independent Claim 1

Claim 1 is challenged as (a) anticipated by Panasonic 792 (Ground 1), (b) anticipated by Panasonic 700 (Ground 4), (c) anticipated by IEEE802.16-2004 (Ground 10), and (d) as obvious over IEEE802.16-2004 and IEEE802.16E-2005 (Ground 11). Patent Owner does not contest the unpatentability of claim 1 or Grounds 1, 4, 10, or 11. PO Resp. 4.

The preamble of claim 1[19] recites, "[a] method of transmitting a preamble sequence in a mobile communication system." Ex. 1001, 18:33–34. Petitioners assert, "Panasonic 792 discloses several techniques for transmitting a random access burst, including a preamble. Ex. 1014, Min. Decl., at ¶ 57 (citing Ex. 1002, Panasonic 792, at § 2.3).)." 758 Pet. 24. Petitioners assert that, based on the disclosure in Table 1 of Panasonic 700

[19] "A preamble does not generally limit the claims." *Allen Eng'g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 1346 (Fed. Cir. 2002) (citation omitted). We need not decide whether the preambles of the claims of the '481 patent are limiting for purposes of this Final Written Decision, however, because we are persuaded that Petitioners have shown that the cited references disclose all elements recited in the preambles of the claims of the '481 patent.

and the related description, "persons skilled in the art would have understood that a RACH [Random Access Channel] preamble, including a preamble sequence, is transmitted in a mobile communication system." 1342 Pet. 27–28 (citing Ex. 1002 (Panasonic 700), Table 1, 2; Ex. 1014 (Min Decl.) ¶¶ 63–64). With regard to IEEE802.16-2004, Petitioners assert:

> IEEE802.16-2004 discloses a method of transmitting a preamble sequence in a wireless communication system: "[t]his standard specifies the air interface of fixed *broadband wireless access (BWA) systems* supporting multimedia services" (Ex. 1005 at Abstract) and the "[Subscriber Station, SS] *shall transmit the long preamble* as defined in 8.3.3.6" (Ex. 1005 at 477). IEEE802.16-2004 specifies in Section 8.3.3.6, entitled "Preamble structure and modulation," that the long preamble defined there includes "frequency domain sequence." Ex. 1005 at 447. *See also* Wells Declaration at ¶ 101.

1349 Pet. 26. Petitioners also show IEEE802.16E-2005 discloses each element of the preamble of claim 1. *Id*. at 58–60. Patent Owner acknowledges the following regarding IEEE802.16E-2005:

> IEEE802.16-2005 is an amendment to the IEEE 802.16 standard published in 2005, which "updates and expands IEEE Std 802.16-2004 to allow for mobile subscriber stations." (Ex. 1057 at 4.) While IEEE802.16-2005 "provides enhancements" to support mobile subscriber stations, the amendment also states that "[f]ixed IEEE 802.16 subscriber capabilities are not compromised." (Ex. 1057 at 43.) In particular, the preamble structure disclosed in IEEE802.16-2004 was unchanged by the 2005 amendment. (*See* Ex. 1057 at 365 (indicating no amendment to preamble structure of § 8.3.3.6).)

PO Resp. 21–22. Based on this record and considering the cited art, we find each of Panasonic 792, Panasonic 700, IEEE802.16-2004, and IEEE802.16E-2005 discloses the elements of the preamble of claim 1.

The first step of claim 1 is "repeating a specific sequence, having a length (L), N times to generate a consecutive sequence having a length (N*L)." Ex. 1001, 18:35–37. Petitioners cite Figure 1 and Section 2.2 of Panasonic 792 as disclosing the elements of this limitation. 758 Pet. 24–25. Petitioners cite Figure 1 and Section 2.2 of Panasonic 700 as disclosing the elements of this limitation. 1342 Pet. 28–32. As acknowledged by Patent Owner, Panasonic 792 and Panasonic 700 disclose identical preamble structures and "are therefore materially identical as it relates to the patentability of the '481 patent claims." PO Resp. 15–16. Panasonic 792 discloses a random access channel (RACH) preamble structure. Ex. 1002, 2. Paragraph 2.2 of Panasonic 792 discloses a preamble structure that consists of a cyclic prefix (CP) and a repeated CAZAC sequence. *Id*. Figure 1 of Panasonic 792 is reproduced below.

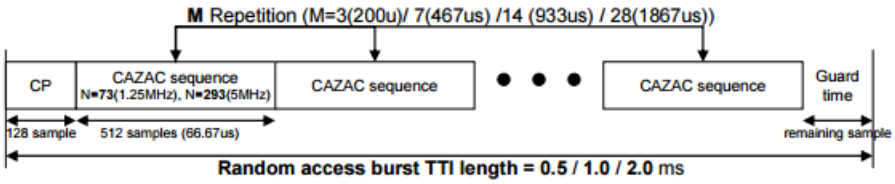

Figure 1 – preamble structure

Figure 1 of Panasonic 792 depicts a "preamble structure" with a cyclic prefix (CP) and "M-times repetition of N=73 (1.25 MHz) or N=293 (5 MHz) CAZAC sequence." *Id*. The relevant disclosure of Panasonic 700 is materially identical. Ex. 1035, Fig. 1, 2.

IEEE802.16-2004 discloses a "long preamble" that:

> [C]onsists of two consecutive OFDM symbols. The first OFDM symbol uses only subcarriers the indices of which are multiples of 4. As a result, the time domain waveform of the first symbol consists of four repetitions of 64-sample fragment, preceded by a CP. The second OFDM symbol utilizes only even subscribers, resulting in time domain structure composed of two repetitions of a 128-sample fragment, preceded by a CP.

Ex. 1054, 483. Figure 205 of IEEE802.16-2004 is reproduced below.

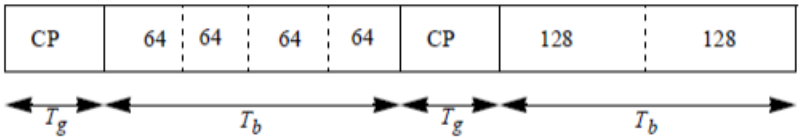

Figure 205—Downlink and network entry preamble structure

Figure 205 of IEEE802.16-2004 depicts a "long preamble" structure including a single cyclic prefix preceding four 64 sample fragments and a single cyclic prefix preceding two 128 sample fragments. Patent Owner acknowledges "the preamble structure disclosed in IEEE802.16-2004 was unchanged by the 2005 amendment. (*See* Ex. 1057, 365 (indicating no amendment to preamble structure of § 8.3.3.6).)" PO Resp. 22. *See also* 1349 Pet. 58–60.

We find each of Panasonic 792, Panasonic 700, IEEE802.16-2004, and IEEE802.16E-2005 discloses all the limitations of the first step of claim 1.

The second step of claim 1 is "generating said preamble sequence by concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence." Ex. 1001, 18:38–40. The Petitioners rely on the same figures and passages cited against the first step of claim 1. 758 Pet. 25–26; 1342 Pet. 32–33; 1349 Pet. 29–30, 58–60. With regard to Panasonic 792 and

Panasonic 700, Petitioners contend, "a person of ordinary skill in the art would have understood that the preamble structure in Figure 1 (*e.g.*, 'said preamble sequence') may be generated by concatenating the cyclic prefix to a front end of the M CAZAC sequence repetitions (*e.g.*, 'the consecutive sequence')." 758 Pet. 26; 1342 Pet. 33. With regard to IEEE802.16-2004 and IEEE802.16E-2005, Petitioners contend:

> IEEE802.16-2004 shows concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence and discloses that "the initial ranging preamble, consists two consecutive OFDM symbols... the time domain waveform of the first symbol consists of four repetitions of 64-sample fragment, preceded by a CP [denoted as 130 in the reproduced Fig. 205 and a] second OFDM symbol . . . of two repetitions of a 128-sample fragment, preceded by a CP [denoted as 230 in the reproduced Fig. 205]."

1349 Pet. 30 (citing Ex. 1054, Fig. 205, 447), 58–60.

With regard to "generating said preamble sequence by concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence," Patent Owner's argument[20] that this limitation is not disclosed in the cited art relies on its claim construction, discussed above, which we did not adopt. PO Resp. 44–47. Patent Owner argues that IEEE802.16-2004 discloses multiple cyclic prefixes, as does Jung which was cited and distinguished on this basis during the prosecution of the '481 patent. *Id*. Thus, Patent Owner contends, as shown in Figure 205 of IEEE802.16-2004 (and as in Fig. 2 of Jung), there is not one and only one cyclic prefix in the preamble. *Id*.

We agree with Petitioners that Figure 205 and the related description

[20] This argument is made in the context of claims 3, 4, 6, 10, 11, and 13, but is based on a limitation that appears in claim 1. *See* PO Resp. 44.

in IEEE802.16-2004 discloses the features of this limitation by disclosing generation of a preamble sequence with at least one repeated specific sequence used to form a consecutive sequence with a single cyclic prefix placed at the front end of the repeated or consecutive sequence. *See, e.g.*, Pet. Reply 19 ("[T]his feature merely requires that the generation of the preamble sequence occur by concatenating a single cyclic prefix to a front end of the **consecutive** sequence. IEEE802.16-2004 plainly discloses this.")

We find each of Panasonic 792, Panasonic 700, IEEE802.16-2004, and IEEE802.16E-2005 discloses all the elements of the second step of claim 1.

The third and last step of claim 1 is "transmitting, on a random access channel, said preamble sequence to a receiving side." Ex. 1001, 18:41–42. "Figure 6 of Panasonic 792 [Ex. 1002] provides five methods by which a preamble is transmitted to a UE [user equipment] to a Node B [base station]." 758 Pet. 26. Panasonic 792 states a "RACH [random access channel] preamble structure is shown in Figure 1." Ex. 1002, 2. Panasonic 700 also teaches transmitting a preamble sequence on a RACH and references both a "transmit antenna" and "receive antennas." 1342 Pet. 33–34 (citing Ex. 1035, 2, 5). IEEE802.16-2004 provides that the subscriber station "shall transmit the long preamble" and that the base station is a "receiving side." Ex. 1054, 477.

We find each of Panasonic 792, Panasonic 700, and IEEE802.16-2004 discloses all the elements of the third and last step of claim 1.

With regard to the rationale for combining the teachings of IEEE802.16-2004 and IEEE802.16E-2005, Petitioners point out that

IEEE802.16E-2005 is an amendment to IEEE802.16-2004 and IEEE802.16E-2005 cites IEEE802.16-2004. 1349 Pet. 57–58. Petitioners also point to the instruction in IEEE802.16E-2005 to "merge the material contained herein into the existing base standard IEEE802.16-2004." *Id.* at 58 (citing Ex. 1057, 1). Petitioners argue, "a PHOSITA reviewing IEEE802.16E-2005 would have referred to and combined its teachings with those of IEEE802.16-2004 so as to gain a full understanding of the 'system for combined fixed and mobile broadband wireless access.'" *Id.* Based on this showing, we find Petitioners articulate reasoning with rational underpinning for combining the relevant teachings of IEEE802.16-2004 and IEEE802.16E-2005. *See KSR*, 550 U.S. at 418. We find a person of ordinary skill in the art would have had reason to combine the teachings of IEEE802.16-2004 and IEEE802.16E-2005.

We conclude that Petitioners demonstrate, by a preponderance of the evidence, that claim 1 is unpatentable under 35 U.S.C. § 102 as anticipated by each of Panasonic 792, Panasonic 700, or IEEE802.16-2004, and under 35 U.S.C. § 103 as having been obvious over IEEE802.16-2004 and IEEE802.16E-2005.

2. Independent Claim 8

Although claim 1 is a method claim and claim 8 is an apparatus claim, claims 1 and 8 contain commensurate limitations stated using almost the exact same language. Ex. 1001, 18:33–42, 18:60–19:3. The only apparatus claim 8 recites is "[a] transmitter for transmitting a preamble sequence," "a preamble generation unit," and "a transmission unit." *Id.* at 18:60–19:3. Patent Owner does not argue that the apparatus recited in claim 8

distinguishes it over the method of claim 1. Therefore, Claim 8 does not present "materially different issues that alter the question of patentability, making [it] patentably distinct" from claim 1. *See Maxlinear, Inc. v. CF Crespe LLC*, No. 2017-1039, 2018 WL 542676, at *3 (Fed. Cir. Jan. 25, 2018).

In addition to citing Panasonic 792, Panasonic 700, IEEE802.16-2004, and IEEE802.16E-2005, Petitioners cite Motorola 595 and Chou against claim 8. 758 Pet. 28–31; 1342 Pet. 44–50; 1349 Pet. 35–41, 61–63.

Motorola 595 discloses circuitry for a base station or mobile station to perform uplink and downlink transmission. Ex. 1040 ¶ 41. Motorola 595 relates to "wireless broadband system development, such as in the 3rd generation partnership project (3GPP) Long Term Evolution (LTE)." *Id*. ¶ 3. Figure 2 of Motorola 595, reproduced above in section I.D.5., depicts circuitry 200 comprising logic circuitry 201, a microprocessor controller, transmit circuitry 202, and receive circuitry 203. *Id*. ¶ 41. Motorola 595 states, "transmitter 202 and receiver 203 are preferably well known transmitters and receivers that utilize a 3GPP network protocol." *Id*.

With regard to the motivation to combine the relevant teachings of the Panasonic references (and Chu) with the relevant teachings of Motorola 595, the Petitioners state:

> Persons skilled in the art would have combined the teachings of the Panasonic references and/or Chu with the specific hardware implementation details provided in Motorola 595. (Ex. 1014, Min Decl., at ¶ 117.) The Panasonic references make reference to a UE at a high level from a functional point of view, but by their very nature, they do not provide all of the specific structural details. (*Id*.) Many structural features such as a transmission unit and preamble generation unit would have

> been routine, common-sense design choices for the skilled artisan, who would have recognized that those features are necessary to implement working LTE devices. (*Id.*) But to the extent the skilled artisan had wanted more information about a UE's structure, the skilled artisan would have logically and predictably consulted a reference such as Motorola 595, which provides a block diagram of the components included in a UE, such as a transmission unit and general purpose microprocessor that can operate as a preamble generation unit. (*Id.*)
>
> The skilled artisan would have also turned to Motorola 595 because it is in the same field of endeavor as Panasonic references concerning the random access procedure and was created by a well-known manufacturer of cellular devices. (*Id*. at ¶ 118.).

1342 Pet. 52–53.

Chou relates to wireless networks and wireless communications. Ex. 1059, 1:9–10. Figure 1 of Chou, reproduced above, depicts a broadband wireless access (BWA) network. *Id.* at 2:3–14. Chou states, "[n]etwork 100 may be based on the IEEE 802.16-2004 standard and/or IEEE 802.16(e) proposed specification" and the base stations may communicate with the subscriber stations (SS) and mobile subscriber stations on physical layer (PHY) configurations using "a SS based on IEEE 802.16-2004." *Id*. at 2:15–16, 5:38–41. Chou also provides, "the downlink PHY data units transmitted by the base station may begin with a long preamble." *Id*. at 6:29–30.

With regard to the motivation to combine the relevant teachings of IEEE 802.16-2004 with the relevant teachings of Chou, the Petitioners state:

> [A] PHOSITA would have found it obvious for the subscriber station as taught by IEEE802.16-2004, the very same standard used by the subscriber stations 104 of Chou, to include an

> internal preamble sequence generation unit. In addition, a PHOSITA would have been led to do so because it was well-known, commonly adopted practice in the art to implement a sequence generation unit as an internal component of a transmitter for transmitting the preamble signal generated by the sequence generation unit in the interest, for example, of reducing cost of extra wirings or other connections of an external sequence generation unit as well as avoiding unnecessary latency and interference caused by the external connection between the subscriber station and the external sequence generation unit. *See* Dr. Wells Dec. at ¶¶ 117-118.

1349 Pet. 39.

We have considered the showing by the Petitioners related to claim 8, the art cited against claim 8 and the articulated reasoning for combining the relevant teachings of the references cited against claim 8. As indicated previously, Patent Owner is no longer contesting the unpatentability of claim 8 or Grounds 1, 7, 14, and 15, which include claim 8. PO Resp. 4. We conclude that Petitioners demonstrate, by a preponderance of the evidence, that claim 8 is unpatentable under 35 U.S.C. § 102 as anticipated by Panasonic 792 and under 35 U.S.C. § 103 as having been obvious over Panasonic 700 and Motorola 595, over IEEE802.16-2004 and Chou, and over IEEE802.16-2004, IEEE802.16E-2005, and Chou.

3. Dependent Claims 2 and 9

Dependent claims 2 and 9 recite generating "said specific sequence from a Constant Amplitude Zero Auto Correlation (CAZAC) sequence." Ex. 1001, 18:43–45, 19:4–7. Patent Owner is not contesting the unpatentability of claims 2 and 9, Grounds 1 and 4, which relate to claim 2, Grounds 12 and 13 as related to claim 2, or Grounds 16 and 17 as related to

claim 9. PO Resp. 4. Pursuant to Ground 1, Petitioners assert claims 2 and 9 are anticipated by Panasonic 792. Pursuant to Ground 4, Petitioners assert claim 2 is anticipated by Panasonic 700. Pursuant to Ground 7, Petitioners assert claim 9 would have been obvious over Panasonic 700 and Motorola 595. Pursuant to Ground 12, Petitioners assert claim 2 would have been obvious over IEEE802.16-2004 and Tan. Pursuant to Ground 13, Petitioners assert claim 2 would have been obvious over IEEE802.16-2004, IEEE802.16E-2005, and Tan. Pursuant to Ground 16, Petitioners assert claim 9 would have been obvious over IEEE802.16-2004, Chou, and Tan. Pursuant to Ground 17, Petitioners assert claim 9 would have been obvious over IEEE802.16-2004, IEEE802.16E-2005, Chou, and Tan.

Figure 1 of Panasonic 792 and Figure 1 of Panasonic 700 depict a preamble, which includes M consecutive repetitions of a CAZAC sequence. Ex. 1002, Figure 1; Ex. 1035, Figure 1.

Tan is titled, "Preamble Sequencing for Random Access Channel in a Communication System." Ex. 1074, (54). Tan teaches the use of "cyclically shifted versions of the signature sequences" and that "the signature sequences are obtained from a constant amplitude zero autocorrelation (CAZAC) sequence." *Id*. at 3:35–36, 3:55–58. Tan states that its teachings are applicable to "systems including 3GGP, 3GPP2, and 802.16 communication systems." *Id*. at 8:17–18.[21]

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[21] Patent Owner argues that claims 3, 4, 6, 10, 11, and 13, which depend directly or indirectly from claims 2 and 9, are not unpatentable because IEEE802.16-2004 fails to teach generating "said specific sequence from a Constant Amplitude Zero Auto Correlation (CAZAC) sequence." PO Resp. 47–51. However, in the combinations which include IEEE802.16-2004 and

We find that the cited art discloses all the limitations of claim 2.

With regard to the motivation to combine the teachings of Tan with IEEE802.16-2004 and IEEE802.16E-2005 (Grounds 12, 13, 16, and 17), the Petitioners state:

> As such, a PHOSITA with access to Tan would have nevertheless been led to generate the specific sequence (i.e., the 64-sample sequence 110 or the 128-sample sequence 210) in the long preamble (as defined in § 8.3.3.6 of the IEEE 802.16 for Initial Ranging) from *a Constant Amplitude Zero Auto Correlation (CAZAC)* sequence of the type described by Tan, because, as Tan notes, the CAZAC sequence has "*low cross correlation at all time lags which improves the detection performance*" especially for random access channels (RACH) of the type taught by Tan. Ex. [1074], 3:59-61. *See* Wells Declaration [Ex. 1052] at ¶¶ 124-127.

1349 Pet. 45.

We find that one of ordinary skill in the art would have been motivated to combine the teachings of IEEE802.16-2004, IEEE802.16E-2005, and Tan.

We conclude both Panasonic 792 and Panasonic 700 anticipate claim 2. We conclude claim 2 would have been obvious in view of a combination of the teachings of IEEE802.16-2004 and Tan and a combination of the teachings of IEEE802.16-2004, IEEE802.16E-2005, and Tan. We conclude

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which are asserted against claims 2 and 9 and claims 3, 4, 6, 10, 11, and 13 (Grounds 12, 13, 16, and 17), Petitioners rely on Tan to teach the use of CAZAC sequences. 1349 Pet. 42–46, 55, 63–64. Patent Owner's argument that claims 3, 4, 6, 10, 11, and 13 are not unpatentable because they include a limitation recited in claims 2 and 9 is difficult to reconcile with Patent Owner's failure to contest the unpatentability of claims 2 and 9.

claim 9 would have been obvious in view of a combination of the teachings of Panasonic 700 and Motorola 595; a combination of the teachings of IEEE802.16-2004, Chou, and Tan; and a combination of the teachings of IEEE802.16-2004, IEEE802.16E-2005, Chou, and Tan.

4. Dependent Claims 3 and 10

Dependent claims 3 and 10 recite applying "a cyclic shift sequence to said specific sequence generated from said CAZAC sequence." Ex. 1001, 18:46–48, 19:8–11. Patent Owner is contesting the unpatentability of claims 3 and 10 and Grounds 2, 5, 8, 12, 13, 16, and 17 as related to claims 3 and 10. PO Resp. 4. However, Patent Owner fails to specifically address claims 3 and 10 or to dispute Petitioners' showing that the cited art teaches the limitations of claims 3 and 10. *See generally* PO Resp. Petitioners rely on Panasonic 114 and IEEE802.16-2004 as disclosing the elements recited in claims 3 and 10. 758 Pet. 32–33; 1342 Pet. 36; 1349 Pet. 46–48.

Panasonic 114 is directed to comparing performance of different types of preamble sequences including cyclic-shifted CAZAC sequences. Ex. 1003, 1. Panasonic 114 discloses, "cyclic-shifted CAZAC sequence has superior performance" and "[a]s the results [sic], we propose to choose cyclic-shifted Zadoff-Chu CAZAC as preamble sequence mainly." *Id*. at 2.

Petitioners contend IEEE802.16-2004 in section 8.3.6.3.7 discloses that preambles are cyclically shifted by M samples. 1349 Pet. 46–48. Section 8.3.6.3.7 of IEEE802.16-2004 states, "[t]he Physical Modifier Information Element indicates that the subsequent allocations shall utilize a preamble and midambles, which are cyclically delayed in time by *M* samples." Ex. 1054, 471.

We find that Panasonic 114 and IEEE802.16-2004 disclose all the elements of claims 3 and 10.

With regard to combining the teachings of the cited Panasonic references, the Petitioners articulate the following reasons:

> (i) All three Panasonic references are in the same narrow field of endeavor: RACH preamble sequence design in 3GPP TSG RAN WG1. IPR2016-00758, Paper 2 ("758 Petition") at 36; IPR2016-01342 ("1342 Petition") at 37.
>
> (ii) The same company, Panasonic, submitted all three Panasonic references to the same 3GPP working group. 758 Petition at 36; 1342 Petition at 37.
>
> (iii) All three Panasonic references are directed to the same problem of optimizing the RACH preamble correlation properties. 758 Petition at 36; 1342 Petition at 37.
>
> (iv) All three Panasonic references propose using repeated preamble sequences. 758 Petition at 37; 1342 Petition at 38.
>
> (v) Panasonic 114 compared certain sequences with cyclic-shifted sequences and concluded that the cyclic-shifted sequences perform even better. 758 Petition at 37; 1342 Petition at 38.

Pet. Reply 14. With regard to combining the teachings of the Panasonic references, Patent Owner argues, "[t]he petitions . . . do not provide the required explanation of how a person of ordinary skill would allegedly combine the limitations." PO Resp. 34. However, "[t]he Petitions explained that skilled artisans would 'incorporate Panasonic 114's cyclic-shifted Zadoff-Chu sequences into Panasonic 792's preamble structure.'" Pet. Reply 16 (citing 758 Pet. 37; 1342 Pet. 38). Petitioners have explained and shown that each of the limitations of the claims is taught or suggested in the cited art and why one of ordinary skill in the art would be motivated to

combine the teachings of the Panasonic references. Petitioners' showing is supported by citations to the art and by an unrebutted declaration of an expert.

Patent Owner argues that, considering the Panasonic references as a whole, Panasonic 114 cannot be combined with Panasonic 792 or Panasonic 700. PO Resp. 39–44. Specifically, Patent Owner argues that Panasonic 792 and Panasonic 700 teach the use of multiple, short CAZAC sequences (Ex. 1002, 2) and that Panasonic 114 states, "cyclic-shifted CAZAC sequence requires relatively long sequence" (Ex. 1003, 3). PO Resp. 40–41. Based on this difference in length, Patent Owner concludes, "Panasonic 114 therefore explicitly teaches that its proposed cyclic-shifted CAZAC sequences cannot be used with the structure of Panasonic 792 or Panasonic 700." *Id*. at 41. This argument is not supported by the teachings of the Panasonic references.

As acknowledged by Patent Owner (*id*. at 37), Panasonic 792 and Panasonic 700, for 1.25 MHz bandwidth, teach the use of a CAZAC sequence of length N=73 and to repeat the CAZAC sequence either 3, 7, 14, or 28 times. Ex. 1002, 2. Thus, Panasonic 792 and Panasonic 700 teach the use of sequences with lengths of N=219, 511, 1022, or 2044. As acknowledged by Patent Owner (PO Resp. 38), Panasonic 114, for 1.25 MHz bandwidth, teaches the use of a sequence with a length of N=449 which can be repeated (N=898). Ex. 1003, 2–3. Patent Owner argues, "[o]ne cannot simply take a sequence of length 449 and plug it into a sequence of length 73." PO Resp. 38. But the Panasonic references teach sequences with overlapping ranges of lengths. Sequence length would not

foreclose combining the teachings of the Panasonic references as Patent Owner argues.

Based on this record, we find Petitioners provide well-supported reasons with rational underpinning for combining the relevant teachings of Panasonic 792, Panasonic 700, and Panasonic 114. *See KSR*, 550 U.S. at 418.

With regard to combining the teachings of IEEE802.16-2004, Chou and Tan, the Petitioners state:

> [A] PHOSITA would have been led to combine IEEE802.16-2004 and Chou to include an internal preamble sequence generation unit inside the subscriber station because Chou discloses such a stand-alone, fully operable subscriber station operating in accordance with the IEEE802.16-2004 standard, and also because it is a well-known, commonly-adopted practice in the art to implement a preamble sequence generation unit as an internal component within a transmitter which transmits a preamble sequence. Accordingly, such a combination would have been the use of a known technique for its ordinary purpose to achieve a predictable result. The combined teachings of IEEE802.16-2004 and Chou discloses both the preamble and body of independent claim 8.
>
> Furthermore, it would have been obvious and advantageous for the same PHOSITA to configure the IEEE802.16-2004/Chou preamble sequence generation unit to generate the specific sequence from Tan's CAZAC sequence for at least the reason that the CAZAC sequence has "low cross correlation at all time lags which improves the detection performance" as described by Tan. Ex. 1026, 3:59-61. *See* Wells Declaration at ¶¶ 144-145.

1349 Pet. 54–55. Based on this showing, we find Petitioners articulate reasoning with rational underpinning for combining the relevant teachings of IEEE802.16-2004, IEEE802.16E-2005, Chou, and Tan.

We find a person of ordinary skill in the art would have been motivated to combine the teachings of the Panasonic references. We find a person of ordinary skill in the art would have motivated to combine the teachings of the IEEE802.16-2004, IEEE802.16E-2005, and Chou.

We conclude that Petitioners demonstrate, by a preponderance of the evidence, that claims 3 and 10 are unpatentable under 35 U.S.C. § 103(a) over the combination of Panasonic 792 and Panasonic 114; the combination of Panasonic 700 and Panasonic 114; the combination of Panasonic 700, Panasonic 114, and Motorola 595; the combination of IEEE802.16-2004 and Tan; the combination of IEEE802.16-2004, IEEE802.16E-2005, and Tan; the combination of IEEE802.16-2004, Chou, and Tan; and the combination of IEEE802.16-2004, IEEE802.16E-2005, Chou and Tan.

5. Dependent Claims 4 and 11

Dependent claims 4 and 11 recite "a value of said applied cyclic shift is determined as an integer multiple of a predetermined circular shift unit." Ex. 1001, 18:49–51, 19:13–15. Patent Owner is contesting the unpatentability of claims 4 and 11 and Grounds 6, 9, 12, 13, 16, and 17 as related to claims 4 and 11. PO Resp. 4. However, Patent Owner fails to specifically address claims 4 and 11 or to dispute Petitioners' showing that the cited art teaches the limitations of claims 4 and 11. *See generally* PO Resp. Petitioners rely on Chu and Tan as teaching the elements recited in claims 4 and 11. 1342 Pet. 39–42; 1349 Pet. 50–51, 63–64.

With regard to Chu, Petitioners argue:

> Chu discloses "a value of said applied cyclic shift is determined as an integer multiple of a predetermined circular shift unit." (*Id.* at ¶ 98.) For example, Chu discloses the Zadoff-Chu sequence as

> follows:
>
> $$a_k = \exp i\frac{M\pi k^2}{N} \qquad \text{(for even N)}$$
>
> $$a_k = \exp i\frac{M\pi k(k+1)}{N} \qquad \text{(for odd N)}$$
>
> (Id. (citing Ex. 1004, Chu, at 2).) Chu also discloses that "certain linear phase shifts of the form exp $i(2\pi qk/N)$, where q is any integer, when introduced into the code also will not affect the correlation. To show this, let the modified sequence be (b_k) where
>
> $$b_k = a_k \exp\frac{i2\pi qk}{N}. \qquad (10)"$$
>
> (Ex. 1004, Chu, at 2.) Persons skilled in the art would have understood that the "linear phase shifts" as described in Chu qualify as "cyclic shifts." (Ex. 1014, Min Decl., at ¶ 99 (citing Ex. 1033, Dahlman, at 389-391).) Therefore, Chu discloses that a value of the applied cyclic shift (e.g., the result of exp $\frac{i2\pi qk}{N}$) is determined as an integer multiple ("q," where "q is *any* integer," Ex. 1004 at 2 (emphasis added)) of a predetermined circular shift unit (*e.g.*, exp $\frac{i2\pi qk}{N}$). (Ex. 1014, Min Decl., at ¶ 99.) Therefore . . . Chu discloses "a value of said applied cyclic shift is determined as an integer multiple of a predetermined circular shift unit."

1342 Pet. 41–42. Thus, Chu teaches mathematical equations for the construction of complex codes. Ex. 1004, 1–2. The purpose is to construct codes with good autocorrelation properties. *Id*. at 1.

With regard to the motivation to combine the teachings of the Panasonic references and the teachings of Chu, the Petitioners' assert:

> The skilled artisan also would have combined the collective Panasonic teachings with Chu's teachings because both Panasonic references expressly cite to the Chu reference. In addition, both Panasonic references expressly disclose using the Zadoff-Chu sequence, first documented and described in the Chu reference more than 30 years earlier. The skilled artisan would have logically and predictably consulted the Chu

> reference to better understand the Zadoff-Chu sequence and its mathematical properties in order to incorporate that sequence into the sequence designs of the Panasonic references.

758 Pet. 41 (citations omitted). *See also* 1342 Pet. 43–44.

With regard to Tan, Petitioners argue:

> Tan discloses that the Chu-sequence or GCL sequence ("*the CAZAC, Chu and GCL sequences can be used interchangeably*." Ex. [1074], 3:61- 62) can be used as the signature sequence and the Chu-sequence is delayed (i.e., cyclically shifted) by a value of a cyclic shift of "30*d*," which is determined as an integer multiple (i.e., *d*) of a predetermined circular shift unit (i.e., 30) . . . Accordingly, a PHOSITA would have been led, based on the teachings of Tan, to use a Chu-sequence for the specific sequence of IEEE802.16-2004 and to determine the cyclic shift applied to the specific sequence by using an integer multiple of a predetermined circular shift, thereby increasing the number of RACH opportunities. *See* Dr. Wells Dec. at ¶139.

1349 Pet. 50–51. Tan states that its teachings are applicable to "systems including 3GGP, 3GPP2, and 802.16 communication systems." Ex. 1074, 8:17–18. And, Petitioners assert, "a PHOSITA also would have been led based on Tan's teachings to apply the cyclic shift (*i.e.*, a cyclic delay of 30*d*) to the Chu-sequence used in the combined IEEE802.16-2004/Tan system to increase the total number of RACH opportunities." 1349 Pet. 53.

We find the cited art teaches all the elements of claims 4 and 11 and Petitioners have shown a reason to combine the relevant teachings of the cited art. We conclude that Petitioners demonstrate, by a preponderance of the evidence, that claims 4 and 11 are unpatentable under 35 U.S.C. § 103 over the combination of Panasonic 700, Panasonic 114, and Chu; the combination of Panasonic 700, Panasonic 114, Chu, and Motorola 595; the combination of IEEE802.16-2004 and Tan; the combination of IEEE802.16-

2004, IEEE802.16E-2005, and Tan; the combination of IEEE802.16-2004, Chou, and Tan; and the combination of IEEE802.16-2004, IEEE802.16E-2005, Chou and Tan.

6. Dependent Claims 6 and 13

Dependent claims 6 and 13 recite "multiplying said specific sequence by an exponential sequence." Ex. 1001, 18:54–56, 20:1–4. Patent Owner is contesting the unpatentability of claims 6 and 13 and Grounds 3, 6, 9, 12, 13, 16, and 17 as relating to claims 6 and 13. PO Resp. 4. However, Patent Owner fails to specifically address claims 6 and 13 or to dispute Petitioners' showing that the cited art teaches the limitations of claims 6 and 13. *See generally* PO Resp. Petitioners rely on Chu and Tan as teaching the limitation recited in claims 6 and 13. 758 Pet. 39–40; 1342 Pet. 42–43; 1349 Pet. 51–53, 57.

Petitioners cite to the same passages in Chu that were discussed above in relation to claims 4 and 11 and make a detailed and well-supported showing that Chu teaches the limitation of claims 6 and 13. 758 Pet. 39–40; 1342 Pet. 42–43. In addition, Petitioners state: "Chu teaches multiplying the specific sequence (*e.g.*, α_k) by an exponential sequence (*e.g.*, exp $\frac{i2\pi qk}{N}$)." 758 Pet. 40; 1342 Pet. 43.

With regard to Tan, Petitioners cite to the same passages in Tan that were discussed above in relation to claims 4 and 11 and make a detailed and well-supported showing that Tan teaches the limitation of claims 6 and 13. 1349 Pet. 51–53, 57.

We find the cited art teaches all the elements of claims 6 and 13 and Petitioners have shown a motivation to combine the relevant teachings of the

cited art. We conclude that Petitioners demonstrate, by a preponderance of the evidence, that claims 6 and 13 are unpatentable under 35 U.S.C. § 103 over the combination of Panasonic 700, Panasonic 114, and Chu; the combination of Panasonic 700, Panasonic 114, Chu, and Motorola 595; the combination of IEEE802.16-2004 and Tan; the combination of IEEE802.16-2004, IEEE802.16E-2005, and Tan; the combination of IEEE802.16-2004, Chou, and Tan; and the combination of IEEE802.16-2004, IEEE802.16E-2005, Chou and Tan.

7. Dependent Claims 15 and 16

Dependent claims 15 and 16 recite "said consecutive sequence comprises at least a first sequence, a second sequence, and an N-th sequence; and said CP is identical to the rear part of said N-th sequence." Ex. 1001, 20:9–16. Patent Owner is not contesting that claims 15 and 16 are unpatentable or contesting Grounds 10, 11, 14, or 15 which relate to claims 15 and 16. PO Resp. 4. Petitioners rely on IEEE802.16-2004 as teaching the elements of claims 15 and 16. 1349 Pet. 31–35, 42.

As depicted in Figure 1 of IEEE802.16-2004, reproduced above, the preamble includes four repetitions of the sequence 110. Ex. 1054, 447. IEEE802.16-2004 states the cyclic prefix is a copy of the last few samples in the sequence. *Id.* at 427. *See also* 1349 Pet. 32–35.

We find the cited art teaches all the elements of claims 15 and 16 and Petitioners have shown a motivation to combine the relevant teachings of the cited art. We conclude that Petitioners demonstrate, by a preponderance of the evidence, that claim 15 is unpatentable under 35 U.S.C. § 102 as anticipated by IEEE802.16-2004 and is unpatentable under 35 U.S.C. § 103

over the combination of IEEE802.16-2004 and IEEE802.16E-2005. We conclude that Petitioners demonstrate, by a preponderance of the evidence, that claim 16 is unpatentable under 35 U.S.C. § 103 over the combination of IEEE802.16-2004 and Chou and the combination of IEEE802.16-2004, IEEE802.16E-2005, and Chou.

III. CONCLUSION

We conclude that Petitioners have proven, by a preponderance of the evidence, that claims 1–4, 6, 8–11, 13, 15, and 16 are unpatentable. The evidence overwhelmingly supports the Petitioners' challenge to these claims and Patent Owner's limited arguments to the contrary lack evidentiary support and are not persuasive.

IV. ORDER

It is

ORDERED that claims 1–4, 6, 8–11, 13, 15, and 16 of U.S. Patent No. 8,218,481 B2 are held to be unpatentable;

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.

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