

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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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.

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Case IPR2016-01209  
Case IPR2016-01280<sup>1</sup>  
Patent 7,746,916 B2

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Before CHRISTOPHER L. CRUMBLEY, PATRICK M. BOUCHER, 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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<sup>1</sup> These cases have been consolidated. Unless otherwise indicated, citations are to the record of IPR2016-01209.

In response to a Petition (Paper 2, “Pet.”) filed in IPR2016-01209 by Apple, Inc. Microsoft Corporation, Microsoft Mobile OY, and Microsoft Mobile, Inc. (f/k/a Nokia, Inc.) (collectively, “Apple Petitioners”), we instituted an *inter partes* review of claims 1–10 of U.S. Patent No. 7,746,916 B2 (“the ’916 patent”). Paper 7 (“Dec.”), 25–26. ZTE (USA) Inc., Samsung Electronics Co., Ltd., Samsung Electronics America, Inc., HTC Corporation, and HTC America, Inc. (collectively, “ZTE Petitioners”), filed a substantially identical Petition in IPR2016-01280 and trial was instituted on the same grounds. Paper 8, 2–3. Thereafter, the proceedings were consolidated, and we required the Apple Petitioners and ZTE Petitioners (collectively, “Petitioners”) to file consolidated papers. *Id.* During the trial, Evolved Wireless LLC (“Patent Owner”) timely filed a Response (Paper 14, “PO Resp.”), to which Petitioners timely filed a Reply (Paper 17, “Reply”). An oral hearing was held on September 15, 2017, and a copy of the transcript was entered into the record. Paper 27 (“Tr.”).

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 the claims on which we instituted trial. Based on the record before us, Petitioners have shown, by a preponderance of the evidence, that claims 1–10 are unpatentable.

## I. BACKGROUND

### A. *Real Parties in Interest and Related Proceedings*

The Apple Petitioners identify Apple, Inc., Microsoft Corporation, Microsoft Mobile OY, Microsoft Mobile, Inc. (f/k/a Nokia Inc.), Microsoft

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Luxembourg International Mobile SARL, and Microsoft Luxembourg USA Mobile SARL as the real parties in interest. Pet. 1. The ZTE Petitioners identify ZTE Corporation, ZTE (USA) Inc., Samsung Electronics Co., Ltd., Samsung Electronics America, Inc., HTC Corporation, and HTC America, Inc. as the real parties in interest in IPR2016-01280 (Paper 2, 1). Patent Owner identifies only itself as a real party in interest and the owner of the '916 patent. Paper 5, 2.

The '916 patent has been asserted in several actions, captioned *Evolved Wireless, LLC v. Apple, Inc.*, C.A. 15-cv-542-SLR (D. Del.); *Evolved Wireless, LLC v. HTC Corp.*, C.A. 15-cv-543-SLR (D. Del.); *Evolved Wireless, LLC v. Lenovo Group Ltd.*, C.A. 15-cv-544-SLR (D. Del.); *Evolved Wireless, LLC v. Samsung Electronics Co. Ltd.*, C.A. 15-cv-545-SLR (D. Del.); *Evolved Wireless, LLC v. ZTE Corp.*, C.A. 15-cv-546-SLR (D. Del.); and *Evolved Wireless, LLC v. Microsoft Corp.*, C.A. 15-cv-547-SLR (D. Del.). Pet. 1; Paper 5, 2–3.

The '916 patent is also the subject of IPR2016-01208 and IPR2016-01277, which are consolidated and in which a final written decision on claims 1–10 is being issued on the same date as this decision.

#### *B. The '916 Patent*

The '916 patent is titled “Method and Apparatus for Generating and Transmitting Code Sequence in a Wireless Communication System.” Ex. 1001, (54). The Specification states, “the code sequence or a code sequence set can be applied to 3<sup>rd</sup> Generation Partnership Project (3GPP) system or 3GPP2 system as well as a Wibro system or a Wimax system.” *Id.* at 17:22–25. Figure 13, which is reproduced below, is a “diagram illustrating

application of circular shift to the generated code sequence after a padding portion is attached.” *Id.* at 3:47–49.

FIG. 13

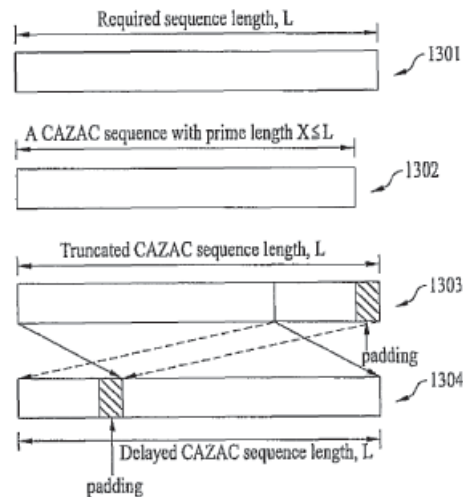


Figure 13 of the '916 patent depicts code sequence 1301 with a “[r]equired sequence length, L”; “CAZAC sequence [1302] with prime length  $X \leq L$ ”; “[t]runcated CAZAC sequence [1303] length, L” with a padding portion added; and “[d]elayed CAZAC sequence [1304] length, L” in which the end portion from code sequence 1303 has been circularly shifted to the start of code sequence 1304. *Id.* at 12:37–49. Thus, the '916 patent describes providing a code sequence for a wireless communication system which is extended by cyclic extension and rearranging the sequence by performing a circular shift.

Claims 1 and 6 of the '916 patent, reproduced below, are independent claims respectively directed at a method of transmitting the above-described sequence and at apparatus for transmitting the above-described sequence.

1. A method for transmitting a code sequence from a transmitting party to a receiving party in a wireless communication system, the method comprising:
  - acquiring a code sequence having a second length by a cyclic extension of a code sequence having a first length;
  - performing a circular shift to the code sequence having the second length; and
  - transmitting the circular shifted code sequence having the second length to the receiving party,wherein the first length is a largest prime number smaller than the second length, and  
wherein the cyclic extension of the code sequence having the first length is performed such that a part of the code sequence having the first length, having a length corresponding to a difference between the first length and the second length, is added to either a start or an end of the code sequence having the first length, and  
wherein the circular shift is performed to the code sequence having the second length such that either a rear portion of the code sequence having the second length moves to a start of the code sequence having the second length, or a front portion of the code sequence having the second length moves to an end of the code sequence having the second length.
6. An apparatus for transmitting a code sequence in a wireless communication system, the apparatus comprising:
  - a code sequence generator for generating a code sequence having a second length by cyclic extension of a code sequence having a first length, and performing a circular shift to the code sequence having the second length; and
  - a transmitting unit for transmitting the circular shifted code sequence having the second length,wherein the first length is a largest prime number smaller than the second length,

wherein the cyclic extension of the code sequence having the first length is performed such that a part of the code sequence having the first length, having a length corresponding to a difference between the first length and the second length, is added to either a start or an end of the code sequence having the first length, and

wherein the circular shift is performed to the code sequence having the second length such that either a rear portion of the code sequence having the second length moves to a start of the code sequence having the second length, or a front portion of the code sequence having the second length moves to an end of the code sequence having the second length.

Ex. 1001, 17:35–57, 18:7–28.

Dependent claims 2 and 7 recite, “the part of the code sequence having the first length comprises at least a cyclic prefix or a cyclic postfix.” *Id.* at 17:58–60, 18:29–31.

Dependent claims 3 and 8 recite, “the cyclic extension is performed such that a cyclic postfix of the code sequence having the first length, having the length corresponding to the difference between the first length and the second length, is added to the end of the code sequence having the first length.” *Id.* at 17:61–66, 18:32–37.

Dependent claims 4 and 9 recite, “the code sequence having the first length is a Zadoff-Chu (ZC) sequence.” *Id.* at 18:1–3, 18:38–40.

Dependent claims 5 and 10 recite, “the code sequence having the second length is transmitted as a reference signal sequence.” *Id.* at 18:4–6, 18:41–43.

### *C. Instituted Grounds of Unpatentability*

We instituted trial challenges of claims 1–10 of the ’916 patent on the following grounds of unpatentability. Dec. 25–26.

| Reference(s)                       | Basis <sup>2</sup> | Challenged Claim(s) |
|------------------------------------|--------------------|---------------------|
| Zhuang175 <sup>3</sup>             | § 102(e)           | 1–3, 5–8, and 10    |
| Zhuang175 and Popović <sup>4</sup> | § 103(a)           | 4 and 9             |
| Zhuang175 and Hou <sup>5</sup>     | § 103(a)           | 1–3, 5–8, and 10    |
| Zhuang175, Hou, and Popović        | § 103(a)           | 4 and 9             |
| Zhuang175 and Fukuta <sup>6</sup>  | § 103(a)           | 6–8 and 10          |
| Zhuang175, Fukuta, and Popović     | § 103(a)           | 9                   |

#### *D. Cited References*

Petitioners assert that Zhuang175, Hou, and Fukuta are prior art to the '916 patent under 35 U.S.C. § 102(e) and Popović is prior art under 35

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<sup>2</sup> 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 '916 patent issued was filed before that date, our citations to Title 35 are to its pre-AIA version.

<sup>3</sup> Zhuang175 (US 7,426,175 B2, filed Mar. 30, 2004, issued Sep. 16, 2008) (Ex. 1012).

<sup>4</sup> Branislav M. Popović, *Generalized Chirp-Like Polyphase Sequences with Optimum Correlation Properties*, 38 IEEE Transactions on Information Theory, 1406–1409 (1992) (Ex. 1009).

<sup>5</sup> Hou et al. (US 8,116,195 B2, filed July 27, 2005, issued Feb. 14, 2012) (Ex. 1011).

<sup>6</sup> Fukuta et al. (US 2007/0270273 A1, filed May 18, 2006, published Nov. 22, 2007) (Ex. 1013).

U.S.C. § 102(b). Pet. 3–5. The earliest possible priority date claimed for the '916 patent is November 28, 2005. Ex. 1001, (30), 1:6–10. Zhuang175 was filed on March 30, 2004 and Hou was filed on July 27, 2005. Popović was published in 1992. Patent Owner does not challenge the prior art status of these references. We find that Zhuang175, Hou, and Popović are prior art.

Fukuta was filed on May 18, 2006. Petitioners assert the '916 patent is not entitled to the earlier filing date of the Korean patent application filed November 28, 2005, from which the '916 patent claims priority. Pet. 4, 14–15; *see* Ex. 1001, (30), 1:6–10. Petitioners assert, “[t]he Korean application filed November 25, 2005 does not support any of the claims of the '916 Patent because it is silent at least on ‘cyclic extension’ and ‘cyclic shift’ features as recited in the claims of the '916 patent.” Pet. 15 n.2 (citing Ex. 1015 (Certified English translation of Korean Patent Application 10-2005-0114306)). Patent Owner does not respond to Petitioners’ argument on this point. We have reviewed the translation of the Korean application and agree with Petitioners that it lacks the support Petitioners identify. Accordingly, we find that the '916 patent is not entitled to the filing date of this earlier filed Korean patent application, and that Fukuta is prior art.

Based on this record, Petitioners have established the cited references are prior art under 35 U.S.C. §§ 102 and 103.

*1. Zhuang175 (Ex. 1012)*

Zhuang175 relates to “a method and apparatus for pilot signal transmission in a communication system.” Ex. 1012, 1:7–8. Zhaung175 states, “[a] pilot signal (or preamble) is commonly used for communication systems to enable the receiver to perform a number of critical functions,

including but not limited to, the acquisition and tracking of timing and frequency synchronization. . . .” *Id.* at 1:11–16. Figure 1 of Zhuang175 is reproduced below.

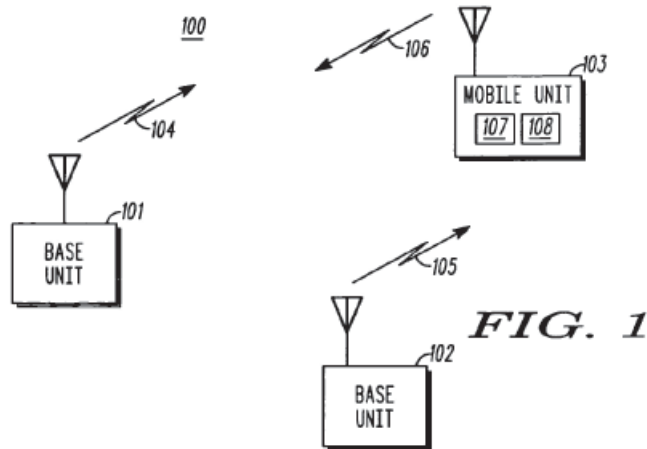


Figure 1 of Zhuang175 depicts a communication system 100 with base units 101 and 102 and remote unit 103. *Id.* at 2:66–67. Figure 2 of Zhuang175 is reproduced below.

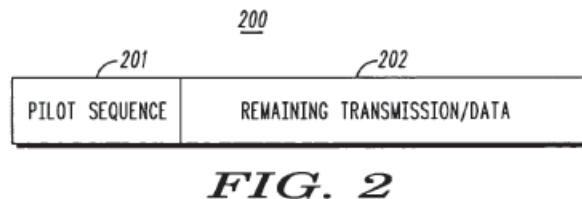


Figure 2 of Zhuang175 depicts a pilot sequence 201 at the beginning of a transmission. *Id.* at 3:45–46. Figure 3 of Zhaung175 is reproduced below.

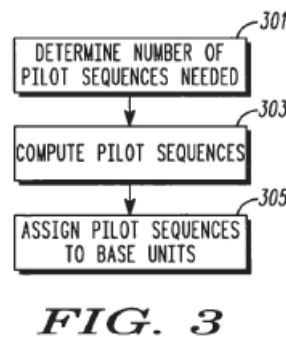


Figure 3 of Zhuang175 depicts a method of “pilot sequence assignment for the communication system.” *Id.* at 2:17–18.

2. *Popović (Ex. 1009)*

Popović is titled, “Generalized Chirp-Like [GCL] Polyphase Sequences with Optimum Correlation Properties.” Ex. 1009, 1406. Popović is an article from IEEE Transactions on Information Theory dated July, 1992. *Id.* Popović relates to “[a] new general class of polyphase sequences with ideal periodic autocorrelation function.” Ex. 1009, 1406 (Abstract). Popović states, “[t]he new class of sequences is based on the application of Zadoff-Chu polyphase sequences.” *Id.* Popović also states, “it was shown that all the cyclic time shifted versions of the Zadoff-Chu sequences have the same absolute value of the aperiodic autocorrelation function.” *Id.* at 1409.

Thus, Popović recommends the use of Zadoff-Chu sequences and specifically discloses cyclic or circular shifted Zadoff-Chu sequences.

3. *Hou (Ex. 1011)*

Hou is titled, “Transmission and Reception of Reference Preamble Signals in OFDMA or OFDM Communication Systems.” Ex. 1011, (54). Hou relates to “[t]echniques for generating preamble sequences for OFDM and OFDMA communication systems based on CAZAC sequences with desired properties of constant amplitudes (CA) and zero autocorrelation (ZAC).” *Id.* at [57] (Abstract). Hou states, “[w]ell-known examples of CAZAC sequences include Chu and Frank-Zadoff sequences.” *Id.* at 3:39–40. Hou explains that if a particular sequence “is a CAZAC sequence in the frequency domain, then its corresponding time-domain sequence is also a

CAZAC sequence” and “the desired properties of the constant-amplitude and zero-auto-correlation of CAZAC sequence are preserved in both time and frequency domain.” *Id.* at 5:12–14, 65–67. Figures 2A and 2B of Hou are reproduced below.

FIG. 2A

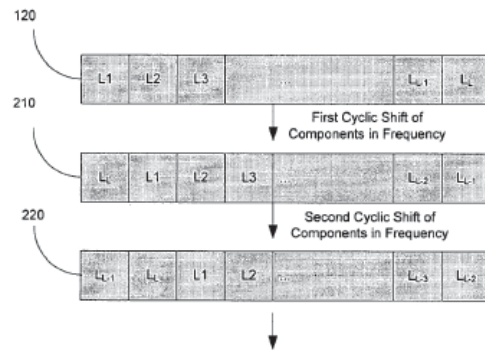


FIG. 2B

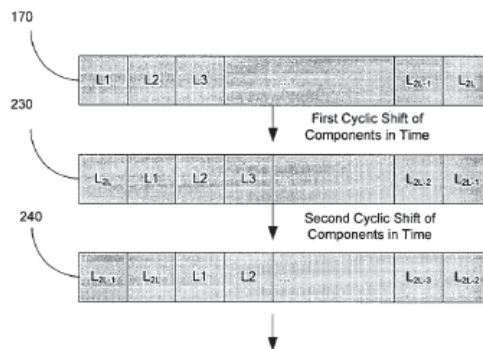


Figure 2A of Hou depicts “an example of using the cyclic shift of initial CAZAC sequence in the frequency domain to generate two new initial CAZAC sequences in the frequency domain,” and Figure 2B of Hou depicts “an example of using the cyclic shift of the preamble sequence in the time domain to generate two new preamble sequences in the time domain.” *Id.* at 3:11–17.

4. *Fukuta (Ex. 1013)*

Fukuta is titled, “Method and Apparatus for Fast Cell Search.” Ex. 1013, [54]. Fukuta relates to “a method and apparatus for fast identification of a service cell or sector during initial or periodic access, or handover in a mobile communication system.” *Id.* ¶ 1. Fukuta states, “[r]eference sequences are constructed from distinct ‘classes’ of GCL sequences that have an optimal cyclic cross correlation property.” *Id.*, [57] (Abstract).

Fukuta teaches generating sequences by choosing a sequence length that is the largest prime number smaller than the desired length of the sequence and performing a cyclic extension to reach the desired length. *Id.* ¶ 37. Fukuta teaches performing a circular shift. *See, e.g., id.* ¶ 66 (“the transformed GCL sequence is shifted such that the first  $m \cdot Q$  entries are eliminated from the front of the sequence and added to the end of the sequence”).

## II. ANALYSIS

### A. 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 Technologies, Inc. v. Am. Sci. & Engineering, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

In the “Claim Construction” section of the Petition, Petitioners

discuss: (1) “acquiring/generating a code sequence having a second length by a cyclic extension of a code sequence having a first length” (claims 1 and 6); (2) “cyclic prefix” (claims 2 and 7); (3) “cyclic postfix” (claims 2, 3, and 7); (4) “reference signal sequence” (claims 5 and 10); (5) “a code sequence generator” (claim 6); and (6) “a transmitting unit” (claim 6). Pet. 5–11.

As discussed more fully below, Patent Owner “is no longer contesting the validity of claims 1–5.” PO Resp. 2. In addition, apart from its arguments directed at underlying independent claim 6, Patent Owner does not present any arguments or contest Petitioners’ assertions relating to the limitations recited in dependent claims 7–10. *See generally* PO Resp. Because those limitations parallel those recited in uncontested dependent claims 2–5, we find it unnecessary to construe expressly any of the individual terms recited in claims 1–5 and 7–10.

And, as Patent Owner presents no argument or evidence relating to any element of the claims other than the first element of claim 6, we do not discuss construction of any terms outside the first element of claim 6.

1. “*code sequence generator*”

Although the parties agree that the term “code sequence generator” as recited in claim 6 should be given its plain and ordinary meaning and no explicit construction is necessary, they argue the meaning of this term. Pet. 8–11; PO Resp. 15–17; Reply 4–7.

Petitioners argue the term “code sequence generator” in claim 6 is not a means-plus-function limitation under 35 U.S.C. § 112 ¶ 6 and “should be given its plain meaning as understood under the BRI standard.” Pet. at 8–9.<sup>7</sup>

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<sup>7</sup> Petitioners present a similar argument relating to “transmitting unit” in

The word “means” is not used in claim 6. As a result, there is a presumption that the limitation is not a means-plus-function limitation that should be construed in accordance with Section 112, paragraph 6. *Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1349 (Fed. Cir. 2015) (en banc) (“When a claim term lacks the word ‘means,’ the presumption can be overcome and §112, para. 6 will apply if the challenger demonstrates that the claim term fails to ‘recite[] sufficiently definite structure’ or else recites ‘function without reciting sufficient structure for performing that function.’” (citation omitted)). On the current record, there is insufficient persuasive argument or evidence to overcome the presumption. Petitioners are not challenging the presumption (Pet. 9) and Patent Owner makes no mention of, and thus takes no position on, this issue. *See generally* PO Resp. We do not construe “code sequence generator” as a means-plus-function limitation.<sup>8</sup>

The existing controversy relating to the term “code sequence generator” relates to whether this term should be construed as limited to a unitary device, as Patent Owner contends. *See* Pet. 10–11 (“the ’916 patent does not limit the recited code sequence generator to a unitary device”); PO

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claim 6 in which it contends this term is not a means-plus-function limitation. Pet. 11. Patent Owner does not present any argument relating to construction of “transmitting unit” or contend the cited art fails to disclose a “transmitting unit.” *See generally* PO Resp.

<sup>8</sup> In the related District Court litigations, Petitioners challenged the presumption and argued this term was a means-plus-function limitation. Pet. 9. Patent Owner argued this term was not a means-plus-function limitation. *Id.* The District Court ruled that Petitioners failed to overcome the presumption and that Section 112, paragraph 6, did not apply to this limitation. *Evolved Wireless, LLC, v. Apple, Inc.*, Civ. No. 15-542-SLR, slip op. at 3–5 (D. Del. Nov. 14, 2016).

Resp. 15 (“a POSITA would understand that the phrase ‘code sequence generator’ refers to a discrete circuit or module within a single device”). Petitioners argue that Patent Owner’s narrower construction finds no support in the Specification. Pet. 10–11. Without taking a position as to whether the phrase “sequence selection unit” corresponds to the claimed “code sequence generator,” Patent Owner argues the term “unit” as used in Figure 16 of the ’916 patent in the phrase “sequence selection unit” “refer[s] to software or logic within a single device.” PO Resp. 16 (“Assuming the ‘sequence selection unit’ refers to the claimed code sequence generator, the term unit would again refer to software or hardware logic within a single device.”) But we find Figure 17 of the ’916 patent, reproduced below, more pertinent to this issue.

**FIG. 17**

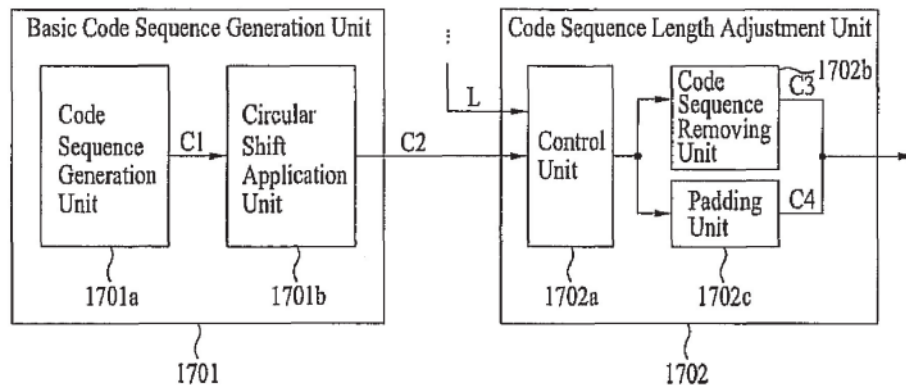


Figure 17 depicts “a structural diagram illustrating a basic code sequence generation unit and a code sequence length adjustment unit.” Ex. 1001, 3:61–63. Figure 17 shows sub-units (the “Circular Shift Application Unit” 1701b of the “Basic Code Sequence Generation Unit” 1701 and the “Padding Unit” 1702c of the “Code Sequence Length Adjustment Unit”

1702), which refer to the functions (“circular shift” and “cyclic extension”) recited as performed by the “code sequence generator” in claim 6. The detailed description of Figure 17 also refers to these sub-units as distinct units performing the functions of the “code sequence generator” in claim 6. *See* Ex. 1001, 15:38–16:7. The Specification does not support construing the phrase “code sequence generator” as a unitary device.

In addition, Patent Owner cites dictionary definitions of “generator,” which contain the singular terms “circuit” and “device.” PO Resp. 14–15. But we agree with Petitioners that a circuit and a device can themselves contain multiple, distinct parts. *See* Reply 4. These dictionary definitions do not support Patent Owner’s proposed construction.

As noted above, 37 C.F.R. § 42.100 (b) provides a claim, “shall be given its broadest reasonable construction in light of the specification of the patent in which it appears.” We conclude that, under the broadest reasonable interpretation of claim 6, the scope of the claim is not limited in the manner proposed by Patent Owner. We do not construe the phrase “code sequence generator” as limited to a unitary device.

2. *“generating a code sequence having a second length by a cyclic extension of a code sequence having a first length”*

The parties argue the construction of the following phrase in claim 6: “generating a code sequence having a second length by a cyclic extension of a code sequence having a first length.” Petitioners argue:

the broadest reasonable interpretation (BRI) of the phrase “acquiring/generating a code sequence having a second length by a cyclic extension of a code sequence having a first length” is broad enough to encompass “acquiring/generating a code sequence having a second length through execution of one or

more operations that include performing a cyclic extension of a code sequence having a first length.”

Pet. 5. Thus, Petitioners argue the word “by” in the context of claims 1 and 6 should be interpreted as expanded to: “through execution of one or more operations that include performing.”

In making this argument, Petitioners fail to cite to the claims, the specification, or the file history, and do not argue the claims, specification, or file history support the proposed interpretation. *Id.* at 5–6. The only support cited is the “plain and ordinary meaning” based on a general purpose dictionary.<sup>9</sup> *Id.*

Patent Owner does not propose a construction of this phrase but, instead, argues Petitioners’ proposed construction broadens the claim language beyond its reasonable meaning and should be rejected. PO Resp. 17–22. At oral argument, Patent Owner clarified its objection to Petitioners’ proposed construction. Tr. 61:21–22 (“Petitioners’ construction allows anything to be put in the middle. Anything.”). Specifically, Patent Owner contends, “Petitioners’ construction would unreasonably allow any number and variety of mathematical operations to occur.” PO Resp. 18; *see also* Tr. 57:6–17. We agree with Patent Owner that Petitioners’ proposed construction is unreasonably broad. Therefore, we do not adopt the construction of this limitation argued by Petitioners.<sup>10</sup>

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<sup>9</sup> American Heritage Dictionary of the English Language (4th ed. 2000) (Ex. 1005).

<sup>10</sup> Although we do not adopt Petitioners’ proposed construction that would unreasonably construe the contested limitation to allow “one or more” undefined operations to occur, we also reject Patent Owner’s argument that this limitation should be construed so as not to allow any additional,

*B. Claims 1–5*

Patent Owner indicates it “is no longer contesting the validity of claims 1–5.” PO Resp. 2. During oral argument, Patent Owner stated that Petitioners “still bear the burden of proof so if the Board believes that what they set forth is sufficient to satisfy that burden, then the Board is free to enter in that judgment.” Tr. 4:17–22. Patent Owner made no arguments as to claims 1–5. *See generally* PO Resp.; Tr. 23–24.

Petitioners challenged, and we instituted trial on, claims 1–3 and 5 on the following grounds: (1) anticipation over Zhuang<sup>175</sup> and (2) obviousness over Zhuang<sup>175</sup> and Hou. Dec. 25. Petitioners challenged, and we instituted trial on, claim 4 on the following grounds: (1) obviousness over Zhuang<sup>175</sup> and Popović and (2) obviousness over Zhuang<sup>175</sup>, Hou, and Popović. *Id.* at 25.

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

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unrecited operations to occur. Tr. 54:11–17 (“the plain meaning of the language says we have a first operation performed and then on the output of that operation, we have a second operation performed . . . to try to put something in to undo the direct connection between the output of Stage 1, the output of the cyclic extension, to the input of the circular shift is just not proper.” *See also* PO Resp. 22–24. We reject both Petitioners’ overly broad **any** undefined operations construction and Patent Owner’s overly narrow **no** unrecited operations implied construction as unreasonable extremes.

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). Furthermore, a petitioner does not satisfy its burden of proving unpatentability by employing “mere conclusory statements.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

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.<sup>11</sup> *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’ declarant,<sup>12</sup> Jonathan Wells, Ph. D., testifies that:

A person of ordinary skill in the art at or before the time of the invention of the ’916 patent (“POSA”) would have had a Master’s of Science Degree in an academic area emphasizing Electrical Engineering, Physics, Computer Engineering, or an equivalent field (or a similar technical Master’s Degree, or higher degree) with a concentration in wireless communication and networking systems. Alternatively, a POSA would have had a Bachelor’s degree (or higher) in an academic area emphasizing Electrical Engineering, Physics, Computer Engineering, or an equivalent field as well as at least 2 years of academic or industry experience in wireless communications and networking systems. A POSA would also have had experience with the wireless Standard Setting Organizations such as ETSI, IEEE, and 3GPP, and would have been familiar with relevant standards and draft standards directed to wireless communications. Additional education in a relevant field, such as electrical engineering or

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<sup>11</sup> The parties do not address secondary considerations, which, accordingly, do not form part of our analysis.

<sup>12</sup> Patent Owner did not submit an expert declaration.

physics, or industry experience may compensate for a deficit in one of the other aspects of the requirements stated above. I am familiar with the knowledge and capabilities of one of ordinary skill in these areas based on my experience working with industry, with undergraduate and post-graduate students, with colleagues from academia, and with engineers practicing in industry.

Ex. 1003 ¶ 34. 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 a method claim. The preamble of claim 1 recites, “[a] method for transmitting a code sequence from a transmitting party to a receiving party in a wireless communication system.” As shown by Petitioners (Pet. 19–20 (citing Wells Decl. ¶¶ 231–235)), Zhuang175 discloses, “a method and apparatus for pilot signal transmission in a communication system.” Ex. 1012, 1:7–8. Zhuang175 states, “base units 101 and 102 transmit known sequences at known time intervals as part of their downlink transmissions. Remote unit 103, knowing the sequence and time interval, utilizes this information in demodulating/decoding the transmissions.” *Id.* at 3:32–36. We find Zhuang175 discloses each element of the preamble of claim 1.

The first step of claim 1 is “acquiring a code sequence having a second length by a cyclic extension of a code sequence having a first length.” As shown by Petitioners (Pet. 20–21 (citing Wells Decl. ¶¶ 236–

238)), Zhuang175 discloses, “[c]hoose  $N_G$  to be the largest prime number that is smaller than  $N_p$  and generate the sequence set. Repeat the beginning elements of each sequence in the set to append at the end to reach the desired length  $N_p$ .” Ex. 1012, 4:18–21. Zhuang175 calls this process “cyclic extension.” *See, e.g., id.* at 4:39. Zhuang175 also states:

the first pilot sequence is of length  $N_p$ , and is based on an extension of a length  $N_G$  Generalized Chirp-Like (GCL) sequence where  $N_G$  is the largest prime number that is smaller than  $N_p$  and the extension is based on appending a repetition of the beginning elements of the GCL sequence to the end to reach the length  $N_p$ .

Ex. 1012, 12:29–34 (claim 16). Claim 20 of Zhuang175 depends from claim 16 and recites that “the first pilot sequence is based on a cyclically extended Generalized Chirp-Like (GCL) sequence.” Ex. 1012, 12:49–51. We find Zhuang175 discloses all the limitations of the first step of claim 1.

The second step of claim 1 is “performing a circular shift to the code sequence having the second length.” As shown by Petitioners (Pet. 21–22 (citing Wells Decl. ¶ 239–241)), Zhuang175 discloses that “the second pilot sequence is based on a function of the first sequence and wherein the function of the first sequence is based on at least one of *circular shifting* of the first sequence and rotating the phase of elements of the first sequence.” Ex. 1012, 12:20–24 (claim 16) (emphasis added). *See also id.* at 6:30–31 (“Examples of the functions applied are circular shifting of the sequence.”). We find Zhuang175 discloses all the limitations of the second step of claim 1.

Petitioners cite Hou as disclosing “that circular shift of a code sequence can be performed in the frequency or in the time domain”<sup>13</sup> citing Figure 2 and the related description at column 3, lines 11–17. Pet. 43–48 (citing Wells Decl. ¶¶ 292–299). We find Hou discloses performing a circular shift to a code sequence in either the frequency domain or time domain.

With regard to the rationale for combining these teachings of Zhuang175 and Hou, Petitioners contend:

A POSITA would have been motivated to perform a circular shift per Hou, as one of the “further modifications,” to Zhuang175’s cyclically extended pilot sequence having a desired pilot length  $N_p$  (i.e., code sequence having the second length), see Ex. 1012, 4:44-46, 6:18-32, in order to obtain additional sequences for synchronization and identification purposes, as suggested by Hou, Ex. 1011, Abstract.

\* \* \*

Moreover, besides Zhuang175’s express disclosure that further modifications can be applied to the circularly extended pilot sequences, see Ex. 1012 at 4:44-46, a POSITA would have had reasons to perform the circular extension before the circular shift. Because, by applying the cyclic extension to the base sequence before that base sequence is cyclically shifted to create additional sequences, the extension operation need be performed only once, rather than on every cyclically shifted version of the base sequence if the opposite order of operations were performed. See Wells Declaration, ¶ 297.

Furthermore, using the circular shift of Hou in the system of Zhuang175 would simply be using a prior art technique for its

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<sup>13</sup> Zhuang175 states, “The length- $N_p$  sequences are assigned to base units in communication system 100 as the time-domain pilot sequence, or as the frequency-domain pilot sequence.” Ex. 1012, 4:47–49.

ordinary purpose (i.e., generating different preamble sequences based on a cyclic shift of CAZAC sequence, Ex. 1011, 7:13-42) to achieve a predictable result (i.e., to increase the number of distinct preamble sequences constructed based on CAZAC sequences, which can be used for synchronization and identification of individual transmitters, *see e.g.*, Ex. 1012, Abstract) and result in an improved system (e.g., the improved Zhuang175 system with increased number of pilot sequences that are available to be assigned to communication units in a communication system, *see e.g.*, Ex. 1012, 6:16-32). *See* Wells Declaration, ¶ 298.

Pet. 45–48. Based on this showing, we find Petitioners articulate reasoning with rational underpinning for combining the relevant teachings of Zhuang175 and Hou. *See KSR*, 550 U.S. at 418. We conclude a person of ordinary skill in the art would have been motivated to combine the teachings of Zhuang175 and Hou.

The third step of claim 1 is “transmitting the circular shifted code sequence having the second length to the receiving party.” As shown by Petitioners (Pet. 22–23 (citing Wells Decl. ¶ 242)), Zhuang175 discloses, “[d]uring operation, pilot channel circuitry within each base unit will transmit the pilot sequence as part of an overall strategy for coherent demodulation.” Ex. 1012, 8:67–9:3. We find Zhuang175 discloses all the limitations of the third step of claim 1.

Claim 1 recites, “wherein the first length is a largest prime number smaller than the second length.” As shown by Petitioners (Pet. 23 (citing Wells Decl. ¶ 243)), Zhuang175 discloses, “[c]hoose  $N_G$  to be the largest prime number that is smaller than  $N_p$ .” Ex. 1012, 4:18–19. We find that Zhuang175 discloses the limitation recited in the first “wherein” clause of

claim 1.

Claim 1 recites:

wherein the cyclic extension of the code sequence having the first length is performed such that a part of the code sequence having the first length, having a length corresponding to a difference between the first length and the second length, is added to either a start or an end of the code sequence having the first length.

As shown above with regard to the first step of claim 1, Zhuang<sup>175</sup> discloses all the limitations recited in the second “wherein” clause of claim 1. *See also* Pet. 23–24 (citing Ex. 1012, 4:19–21 and Wells Decl. ¶ 244–245).

Claim 1 recites:

wherein the circular shift is performed to the code sequence having the second length such that either a rear portion of the code sequence having the second length moves to a start of the code sequence having the second length, or a front portion of the code sequence having the second length moves to an end of the code sequence having the second length.

As shown above with regard to the second step of claim 1, Zhuang<sup>175</sup> discloses all the limitations recited in the third “wherein” clause of claim 1. *See also* Pet. 24–25 (citing Ex. 1012, 6:18–32 and claim 16 and Wells Decl. ¶¶ 246–249).<sup>14</sup>

Petitioners also cites Hou as teaching the limitations of the third “wherein” clause of claim 1. Pet. 40–42 (citing Wells Decl. 279–304). Particularly, Petitioners cite to Hou’s disclosure of applying one or more

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<sup>14</sup> Additionally, Petitioners cite a technical dictionary definition, which defines circular shift and cyclic shift as, “[a] computer shift in which the digits dropped off at one end of a word are returned at the other end of the word.” Pet. 25 n. 4 (citing McGraw-Hill Dictionary of Scientific and Technical Terms (6<sup>th</sup> ed. 2003) (Ex. 1014 at 396, 534)).

cyclic shifts in either the frequency or time domains. *Id.* at 40–41 (citing Ex. 1011, 3:11–17, 7:18–42 and Wells Decl. ¶¶ 287, 289). We find Hou teaches all the limitations recited in the third “wherein” clause of claim 1.

As noted above, Patent Owner presents no arguments or evidence in support of the patentability of claim 1. 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 Zhuang<sup>175</sup> and under 35 U.S.C. § 103 as obvious over Zhuang<sup>175</sup> and Hou.

## 2. *Dependent Claims 2–5*

Patent Owner fails to contest any part of Petitioners’ showing with regard to dependent claims 2–5. *See generally* PO Resp.

Dependent claim 2 recites, “[t]he method according to claim 1, wherein the part of the code sequence having the first length comprises at least a cyclic prefix or a cyclic postfix.” The ’916 patent states, “the padding portion can be comprised of a repeated portion. In other words, the portion corresponding to L-X of the code sequence 1204 can be duplicated and inserted/attached to the end of the code sequence 1204. This can be referred to as *cyclic postfix*.” Ex. 1001, 13:53–57 (emphasis added). As discussed above with regard to the first step of claim 1, Zhuang<sup>175</sup> discloses, “[c]hoose  $N_G$  to be the largest prime number that is smaller than  $N_p$  and generate the sequence set. Repeat the beginning elements of each sequence in the set to append at the end to reach the desired length  $N_p$ .” Ex. 1012, 4:18–21. *See also* Pet. 25–26 (citing Wells Decl. ¶¶ 250–251). We find that the cited art discloses all the limitations of claim 2.

Dependent claim 3 recites, “[t]he method according to claim 1, wherein the cyclic extension is performed such that a cyclic postfix of the code sequence having the first length, having the length corresponding to the difference between the first length and the second length, is added to the end of the code sequence having the first length.” Petitioners cite the same passage in Zhuang175 cited against claim 2. Pet. 26 (citing Ex. 1012, 4:10–21, claim 16, and the Wells Decl. ¶ 252.). We find that the cited art discloses all the limitations of claim 3.

Dependent claim 4 recites, “[t]he method according to claim 1, wherein the code sequence having the first length is a Zadoff-Chu (ZC) sequence.” Petitioners cite Popović as disclosing the use of Zadoff-Chu sequences in the same context as the method of claim 1. *Id.* at 35–39 (citing Wells. Decl. 268–278). As noted earlier, Popović recommends the use of Zadoff-Chu sequences and specifically discloses cyclic or circular shifted Zadoff-Chu sequences. *See, e.g.*, Ex. 1009, 1406 (Abstract). And, in the “Background of the Invention,” the ’916 patent states, “[w]ith respect to CAZAC (Constant Amplitude Zero Auto-Correlation) sequence types, GCL CAZAC and Zadoff-Chu CAZAC are often used.” Ex. 1001, 1:40–42. We find that the cited art discloses all the limitations of claim 4.

With regard to the rationale for combining the teachings of Zhuang327 and Popović, the Petition asserts:

It would have been obvious to a POSITA to combine Zhuang175 and Popovic because, as Popovic explains, a ZC sequence is indeed a special case of “the new, more general, class of polyphaser sequences” (i.e., “generalized chirp-like [GCL] sequences”) that have “optimum periodic autocorrelation and crosscorrelation function properties,” which is consistent with

the motivations of using GCL sequences in Zhuang327. *See* Ex. 1009, 1406, col. 2, 1407, cols. 1 & 2; . 1012, 5:9-15, %:35-6:14.-41.

Furthermore, although the GCL sequence is a “more general” sequence than the ZC sequence, its generation does require more computations than the ZC sequence because the GCL sequence  $\{s_k\}$  is defined as  $s_k = a_k b_{(k) \bmod m}$ ,  $k = 0, 1, \dots, N - 1$ , (7) where  $(k) \bmod m$  means that index  $k$  is reduced modulo  $m$ ” and “ $\{a_k\}$  is the Zadoff-Chu sequence.” Ex. 1009, 1407, cols. 1-2. In other words, the GCL sequence is obtained by further multiplying the ZC sequence with another sequence  $\{b_k\}$ , which is a “sequence of  $m$  complex numbers having the absolute values equal to 1.” Ex. 1009, 1407, col. 1. A POSITA would have been motivated to choose the ZC sequences over the GCL sequences in practical systems because the ZC sequences provide the same optimal auto- and cross-correlation properties (i.e., the properties of interest in Zhuang175) as GCL sequences while requiring less computations in generation by saving the multiplications with the sequence  $\{b_k\}$  of complex numbers that are required in generating the GCL sequences. Such computational advantages can, for example, decrease the loads on the processing units that generate the sequences thereby resulting in power savings, which are particularly important for mobile devices for uplink communications. *See* Wells Declaration, ¶ 276. Accordingly, the code sequence having the first length could have been a ZC sequence in view of the combined teachings of Zhuang175 and Popovic. *See* Wells Declaration, ¶¶ 268-277.

Pet. 38–39. Based on this showing, we find Petitioners articulate reasoning with rational underpinning for combining the relevant teachings of Zhuang175 and Popović. *See* KSR, 550 U.S. at 418. We conclude a person of ordinary skill in the art would have combined the teachings of Zhuang175 and Popović.

Dependent claim 5 recites, “[t]he method according to claim 1, wherein the code sequence having the second length is transmitted as a

reference signal sequence.” According to the “Background of the Invention” in the ’916 patent, a reference signal is “used for initial synchronization, cell search, and channel estimation.” Ex. 1001, 1:21–22. As shown by Petitioners (Pet. 27 (citing Wells Decl. ¶ 253)), Zhuang175 discloses that the code sequence having the second length  $N_p$  is assigned to the base units and transmitted as a pilot sequence. Ex. 1012, 8:61-9:3. The pilot sequence is used for “acquisition and tracking of timing and frequency synchronization, the estimation and tracking of desired channels for subsequent demodulation and decoding of the information data.” *Id.* at 1:12-19. Zhuang175 also discloses using the pilot sequence “to achieve good initial acquisition of synchronization to the desired base unit. ... The fine tuning of the timing and frequency offset can be achieved as in the initial acquisition step.” *Id.* at 8:19-41. Zhuang175 further discloses using the pilot sequence for “signal channel estimation” and “multiple channel estimation.” *Id.* at 6:42-8:18. Thus, Zhuang175 discloses that the code sequence having the second length  $N_p$  is transmitted as a reference signal sequence, i.e., it is a sequence transmitted for the purpose of initial synchronization and channel estimation. We find that the cited art discloses all the limitations of claim 5.

As noted above, Patent Owner presents no arguments or evidence in support of the patentability of claims 2–5. We conclude that Petitioners demonstrate, by a preponderance of the evidence, that claims 2, 3, and 5 are unpatentable under 35 U.S.C. § 102(e) over Zhuang175 and under 35 U.S.C. § 103(a) over a combination of Zhuang175 and Hou. We conclude that Petitioners demonstrate, by a preponderance of the evidence, that claim 4 is

unpatentable under 35 U.S.C. § 103(a) over the combinations of Zhuang175 and Popović and of Zhuang175, Popović, and Hou.

*C. Claims 6–10*

Petitioners challenged, and we instituted trial on, claims 6–8 and 10 on the following grounds: (1) anticipation over Zhuang175; (2) obviousness over Zhuang175 and Hou; and (3) obviousness over Zhuang327 and Fukuta. Dec. 25–26. Petitioners challenged, and we instituted trial on, claim 9 on the following grounds: (1) obviousness over Zhuang175 and Popović; (2) obviousness over Zhuang175, Hou, and Popović; and Zhuang175, Fukuta, and Popović. *Id.*

*1. Independent Claim 6*

Independent claim 6 is the only claim for which Patent Owner presents independent argument. *See generally* PO Resp. Claim 6 is very similar to claim 1. Claim 6 is a device<sup>15</sup> claim but otherwise recites almost<sup>16</sup> the exact same functional language as method claim 1. *See Accenture Glob. Servs., GmbH v. Guidewire Software, Inc.*, 728 F.3d 1336, 1344 (Fed. Cir. 2013) (“Because the system claim and method claim contain only ‘minor differences in terminology [but] require performance of the same basic process,’ they should rise or fall together.” (citation omitted)). Patent Owner argues claim 6 is not unpatentable, but Petitioners’ showing that claim 1 is unpatentable is not contested in whole or in part by Patent Owner. As stated

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<sup>15</sup> The only device limitations recited in claim 6 are “apparatus” in the preamble, “generator” in the first element, and “unit” in the second element.

<sup>16</sup> Claim 1 recites, “acquiring a code sequence.” Claim 6 recites, “generating a code sequence.” Otherwise, the functional language of claim 6 is exactly the same as that of claim 1.

by Petitioners, “[i]n essence, [Patent Owner] argues that claims 6–10 are valid because they recite an *apparatus*, despite the apparatus performing *known* methods.” Reply 1.

Claim 6 is an apparatus claim. The preamble of claim 6 recites, “[a]n apparatus for transmitting a code sequence in a wireless communication system.” As shown by Petitioners (Pet. 28 (citing Wells Decl. ¶¶ 231–235)), Zhuang175 discloses, an “apparatus for pilot signal transmission in a communication system.” Ex. 1012, 1:7–8. Zhuang175 states, “[t]he present invention encompasses a communication unit comprising pilot channel circuitry for transmitting or receiving a pilot channel sequence, wherein the pilot channel sequence comprises a sequence unique to the communication unit and is constructed from a GCL sequence.” *Id.* at 2:49–53; *see also id.* at Figure 1, 11:36–61 (claim 13 directed to a “communication unit”). We find Zhuang175 discloses the preamble of claim 6.

The first element of claim 6 recites, “a code sequence generator for generating a code sequence having a second length by cyclic extension of a code sequence having a first length, and performing a circular shift to the code sequence having the second length.” As shown in the previous paragraph, Zhuang175 states it is directed to apparatus including a communication unit. The functions of this element were shown to be disclosed by Zhuang175 (and, with regard to the circular shift, Hou) in the discussion above relating to the first two steps of claim 1. Zhuang175 discloses, “[a] communication unit comprising: pilot channel circuitry for transmitting . . . a first pilot channel sequence . . . and a second pilot channel sequence.” Ex. 1012, 11:36–45. The “first pilot sequence . . . is based on

appending a repetition of the beginning elements of the GCL sequence to the end to reach the length  $N_p$ .” *Id.* at 13:29–34. The “second pilot sequence . . . is based on at least one of circular shifting of the first sequence.” *Id.* at 20–23; *see also* Pet. 30–33 (citing Wells Decl. ¶¶ 139–144). Patent Owner acknowledges:

Zhuang175 explains that pilot sequences are computed by first determining a desired pilot length  $N_p$  and then selecting a starting sequence of prime number length  $N_G$  and performing modifications, including either truncation or extension. (Ex. 1012 at 3:64-4:13.) Once these modifications are performed, the pilot sequences of length  $N_p$  are assigned to the base units. (Ex. 1012 at 4:47-51.) Zhuang175 explains that once assigned to the base units, “the actual signals may be the results of different functions of the same assigned sequence. Examples of the functions applied are circular shifting of the sequence, rotating the phase of the sequence elements, etc.” (Ex. 1012 at 6:25-32.)

PO Resp. 11. Accordingly, the base or communication unit of Zhuang175 is a code sequence generator, as it is an apparatus generating a code sequence having a second length by cyclic extension of a code sequence having a first length, and performing a circular shift to the code sequence having the second length and, thus, discloses all the limitations of the first element of claim 6.

Patent Owner argues that Zhuang175 fails to disclose the first element of claim 6 because, “Zhuang175 does not expressly disclose the claimed ‘code sequence generator’ within one device that performs both a cyclic extension and circular shift.” PO Resp. 24–30. However, this argument is based on Patent Owner’s proffered construction of “generator” in the context

of claim 6 as a unitary device. As we decline to interpret claim 6 in this manner, we do not find this argument persuasive.

In the alternative, Petitioners also contend that Fukuta teaches or suggests all the limitations of the first element of claim 6 being performed in a unitary device. Pet. 52–61. Fukuta discloses constructing code sequences from GCL sequences. *See, e.g.*, Abstract, ¶ 21 (“reference sequences are constructed from distinct ‘classes’ of GCL sequences that have an optimal cyclic cross correlation property.”). Fukuta discloses performing cyclic extension, in paragraph 37, which states, “[c]hoose  $N_G$  to be the largest prime number that is smaller than  $N_p$  and generate the sequence set. Repeat the beginning elements of each sequence in the set to append at the end to reach the desired length  $N_p$ .”<sup>17</sup> Ex. 1013 ¶ 37. Paragraph 40 of Fukuta states, “[i]t should also be noted the while only sequence truncation and *cyclic extension* were described above, in alternate embodiments of the present invention there exist other ways to modify the GCL sequences to obtain the final sequences of the desired length.” *Id.* at ¶ 40 (emphasis added).

Petitioners show that Figure 4 and the related description in Fukuta discloses a unitary device (base unit or transmitter 107 (*see* Figure 1)) which

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<sup>17</sup> As shown above, Zhuang175 contains this exact same language. Ex. 1012, 4:18–21. As Petitioners point out, Zhuang175 and Fukuta have the same assignee and very similar disclosures. Pet. 53–55. Zhuang175 and Fukuta are closely related art and directed to the same field of endeavor. We agree with Petitioners (*see* Pet. 54) and find that Zhaung175 and Fukuta are in the same field of endeavor as, and analogous art to, the ’916 patent.

generates the code sequence and performs a circular shift. Pet. 55–59.

Figure 4 of Fukuta is reproduced below.

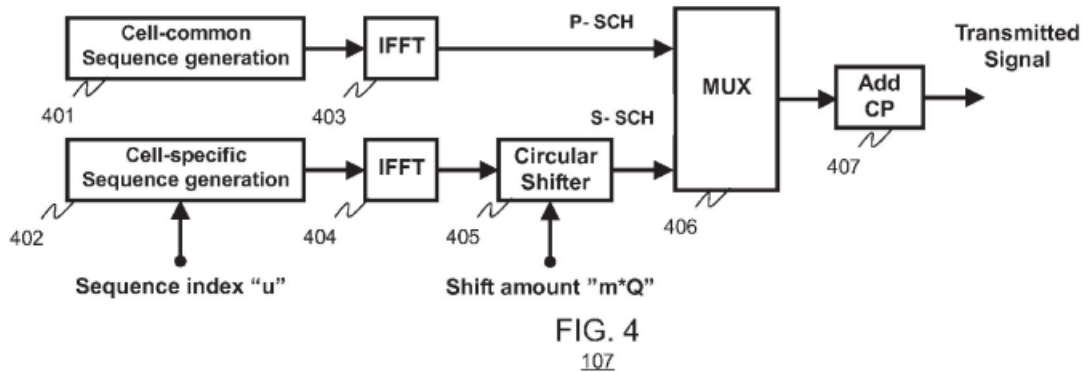


Figure 4 depicts “a block diagram of transmitter 107.” Ex. 1013 ¶ 54.

Figure 4 includes, “circular shifter 405 for circular shifting the secondary synchronization sequence.” *Id.* ¶ 53. Fukuta describes the operation of the base unit or transmitter 107 as follows:

During operation, a cell common sequence is generated by generator 401 and is passed to IFFT 403, where the sequence is transformed to a time domain signal. Cell specific GCL sequence with unique sequence index (u) is generated by generator 402 and is passed to IFFT 404, where the sequence is transformed to time domain signal. The cell specific time domain signal is circularly shifted by shifter 405.

*Id.* ¶ 54. Figure 8 of Fukuta and the related description also disclose a transmitter unit which generates a reference sequence and performs a circular shift. *Id.* at Figure 8, ¶¶ 65–70. We find Fukuta discloses a transmitter or base unit that generates a cyclic extended code sequence and performs a circular shift on that code sequence.

Patent Owner argues that Fukuta fails to meet the limitations of the first element of claim 1 because, “Figures 4 and 8 of Fukuta, relied on by Petitioners, however, disclose that an IFFT is performed prior to a circular

shift.” PO Resp. 30–34. Whether or not an additional mathematical operation such as an Inverse Fast Fourier Transformation (IFFT) of the sequence is performed, Fukuta discloses generating a code sequence having a second length by cyclic extension of a code sequence having a first length under the plain and ordinary meaning of the first element of claim 6.<sup>18</sup> And, Patent Owner does not dispute that Fukuta discloses performing a circular shift to a code sequence having the second length which was generated through the cyclic extension and IFFT.

The purpose of the IFFT is to transform a frequency domain signal to a time domain signal, which is necessary in processing the access sequences. Ex. 1013 ¶ 54 (Fukuta) (“a cell common sequence is generated by generator 401 and is passed to IFFT 403, where the sequence is transformed to a time domain signal.”). The ’916 patent describes performing an IFFT for this same purpose prior to transmitting the code symbols of the sequence. Ex. 1001, 4:46–49 (“the data symbols mapped to subcarriers are processed by an inverse fast Fourier transform (IFFT) module 15 [of Figure 1] which transform the data symbols into a signal in the time domain.”).<sup>19</sup> For these reasons, we disagree with Patent Owner that the inclusion of an IFFT between the cyclic extension and the cyclic shift prevents Zhuang175 from reading on the first element of claim 6.

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<sup>18</sup> Patent Owner does not contend that the IFFT changes the length. Tr. 53:12–14; 54:18–22.

<sup>19</sup> Patent Owner acknowledges, in the related case also involving the same claims of the ’916 patent, that “the plain language of the claims is agnostic as to the domain of the generated code sequences.” IPR2016-01208, Paper 14 (PO Resp.) 25.

In addition to noting that Zhuang175 and Fukuta are closely related art, Petitioners assert it would have been obvious to combine the teachings of Zhuang175 and Fukuta because:

Zhuang175's "pilot channel circuitry 107" corresponds to Fukuta's transmitter 107: "each base unit within communication system 100 comprises pilot channel circuitry 107 that transmits one or more pilot sequences." Ex. 1013, 3:41-44. Accordingly, it would have been obvious that Zhuang175's "pilot channel circuitry 107" would have included or been modified to include a cell-specific sequence generator for generating a code sequence by cyclic extension and a circular shifter for circular shift the code sequence, as taught by Fukuta. Such an implementation would simply be using a known technique or device for its ordinary purposes (i.e., using Fukuta's known cell-specific sequence generator 402 for generating a GCL signal including the operation of cyclic extension, and circular shifter 405 for circularly shifting a code sequence) in the same way (i.e., generating a code sequence having a second length by cyclic extension of a code sequence having a first length, and performing a circular shift to a code sequence having a second length) for similar devices (i.e., Zhuang175's "pilot channel circuitry 107" versus Fukuta's "transmitter 107") to achieve a predictable result (e.g., generating a pilot sequence for transmission by the base unit in communication system 100). See e.g., Ex. 1012, 8:56-9:3. See Wells Declaration, ¶ 325.

Pet. 59–60. Based on this showing, we find Petitioners articulate reasoning with rational underpinning for combining the relevant teachings of Zhuang175 and Fukuta. See *KSR*, 550 U.S. at 418. We conclude a person of ordinary skill in the art would have combined the teachings of Zhuang175 and Fukuta.

With regard to the rationale for combining Zhuang175 and Fukuta, Patent Owner argues, "Petitioners fail to articulate a reason to remove the

IFFT module from Fukuta's transmitter." PO Resp. 35–37. Specifically, Patent Owner argues, "Fukuta does not disclose the claimed algorithm implemented by the 'code sequence generator' because Fukuta requires circularly shifting an IFFT of the extended sequence." *Id.* at 35–36. As noted previously, we do not find it is necessary for the IFFT module to be removed from Fukuta's transmitter in order to read the limitations of the first element of claim 1 on the transmitting unit of Fukuta. Fukuta teaches all the limitations of the first element of claim 1.

Moreover, Petitioners present the following argument as to why a person of ordinary skill in the art would have found it obvious to combine the relevant teachings of Zhuang175 and Fukuta in such a way as to perform the circular shift directly on the cyclically extended code sequences without an intervening IFFT:

Zhuang175 discloses that "[t]he length- $N_p$  sequences are assigned to base units in communication system 100 *as the time-domain pilot sequence, or as the frequency-domain pilot sequence*," Ex. 1012, 4:47-51. "[D]ifferent functions [can be applied to] the same assigned sequence. Examples of the functions applied are circular shifting of the sequence, rotating the phase of the sequence elements," see Ex. 1012, 6:18-32, claim 16. A POSITA would have readily understood that Zhuang175 discloses circular shifting can be *directly* applied to the assigned length- $N_p$  sequence without domain conversion. Thus, no IFFT in between the cell-specific sequence generator and the circular shifter is needed for the "code sequence generator" for performing Zhuang175's disclosed functions of generating a code sequence having a second length by cyclic extension of a code sequence having a first length, and performing a circular shift to the code sequence having the second length. See Wells Declaration, ¶¶ 328-330. Such a modification would have been well within the knowledge and

capabilities of a POSITA because the circular shifter 405 of Fukuta is a network element “*configured in well known manners with processors, memories, instruction sets, and the like, which function in any suitable manner to perform the function set forth herein,*” Ex. 1013, ¶ 0030; Wells Declaration, ¶ 331. To be sure, Fukuta does not limit the circular shifter 405 or 803 to perform circular shift in time domain only. Indeed, a POSITA would have found it obvious and advantageous that the circular shifter is domain-agnostic because Fukuta discloses the function of the circular shifter is merely manipulation of entries (essentially, numbers) of a sequence such that “the transformed GCL sequence is shifted such that the first  $m \cdot Q$  entries are eliminated from the front of the sequence and added to the end of the sequence,” regardless of the domain of the sequence or the entries of the sequence. Ex. 1013, ¶ 0066; Wells Declaration, ¶ 332.

Moreover, using a circular shifter to manipulate frequency-domain entries of a frequency-domain sequence input into the circular shifter would simply have been using a prior art structure (e.g., a circular shifter) for its known purpose (performing a circular shift of a code sequence) to achieve a predictable result (i.e., such that the first few entries are eliminated from the front of the sequence and added to the end of the sequence). See Wells Declaration, ¶ 333.

Pet. 62–63. We find Petitioners’ argument and evidence to be persuasive. The combination of Zhuang<sup>175</sup> and Fukuta clearly teaches generating a code sequence by cyclic extension and circular shifting. We find the combination also teaches that the IFFT is performed in order to transform a code sequence from a frequency domain to a time domain. Based on these teachings, a person of ordinary skill in the art would appreciate that a code sequence in either the frequency or time domain could be generated with a cyclic extension and circular shift without performing an intervening IFFT.

We find the cited art discloses all the limitations of the first element of claim 6.

The second element of claim 6 recites, “a transmitting unit for transmitting the circular shifted code sequence having the second length.” As shown by Petitioners (Pet. 28 (citing Wells Decl. ¶¶ 231–235)), Zhuang175 discloses, “apparatus for pilot signal transmission in a communication system” including “a base unit within communication system 100 compris[ing] pilot channel circuitry that transmits one or more pilot sequences.” Ex. 1012, 1:6–8, 3:41–43. As noted above, Fukuta also teaches transmitting or base units for transmitting the circular shifted code sequence having the second length. *See, e.g.*, Fig. 4. We find Zhuang175 and Fukuta disclose all the limitations of the second element of claim 6.

The remaining three elements of claim 6 recite:

wherein the first length is a largest prime number smaller than the second length,

wherein the cyclic extension of the code sequence having the first length is performed such that a part of the code sequence having the first length, having a length corresponding to a difference between the first length and the second length, is added to either a start or an end of the code sequence having the first length, and

wherein the circular shift is performed to the code sequence having the second length such that either a rear portion of the code sequence having the second length moves to a start of the code sequence having the second length, or a front portion of the code sequence having the second length moves to an end of the code sequence having the second length.

Zhuang175 discloses these elements as shown above with regard to claim 1.

Fukuta teaches these elements as shown above with regard to claim 6. Hou

teaches the elements of the last “wherein” element as shown above with regard to claim 1. We find the cited art discloses all the limitations of the “wherein” clauses of claim 6.

We conclude that Petitioners demonstrate, by a preponderance of the evidence, that claim 6 is unpatentable under 35 U.S.C. § 102 over Zhuang175 and under 35 U.S.C. § 103 over a combination of Zhuang175 and Hou and a combination of Zhuang175 and Fukuta.

## *2. Dependent Claims 7–10*

Claim 7 recites the same element as claim 2, claim 8 recites the same element as claim 3, and claim 9 recites the same element as claim 4, and claim 10 recites the same element as claim 10. As shown above with regard to claims 2–5, respectively, the cited art teaches the elements recited in claims 7–10.

Patent Owner fails to contest any part of Petitioners’ showing with regard to dependent claims 7–10. *See generally* PO Resp. Based on this record, we conclude that Petitioners demonstrate, by a preponderance of the evidence, that claims 7–10 are unpatentable.

## III. CONCLUSION

For the foregoing reasons, we conclude that Petitioners have proven, by a preponderance of the evidence, that claims 1–10 are unpatentable.

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#### IV. ORDER

It is

ORDERED that, based on a preponderance of the evidence, claims 1–10 of US 7,746,916 B2 are held to be unpatentable;

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.

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PETITIONERS:

Walter Renner  
[IPR00035-0006IP2@fr.com](mailto:IPR00035-0006IP2@fr.com)

Charles McMahon  
[cmcmahon@mwe.com](mailto:cmcmahon@mwe.com)

Roberto Devoto  
[PTABInbound@fr.com](mailto:PTABInbound@fr.com)

Hersh Mehta  
[hmehta@mwe.com](mailto:hmehta@mwe.com)

James Glass  
[jimglass@quinnemanuel.com](mailto:jimglass@quinnemanuel.com)

Kevin Johnson  
[kevinjohnson@quinnemanuel.com](mailto:kevinjohnson@quinnemanuel.com)

Todd Briggs  
[toddbriggs@quinnemanuel.com](mailto:toddbriggs@quinnemanuel.com)

John McKee  
[johnmckee@quinnemanuel.com](mailto:johnmckee@quinnemanuel.com)

Stephen Korniczky  
[skorniczky@sheppardmullin.com](mailto:skorniczky@sheppardmullin.com)

Martin Bader  
[mbader@sheppardmullin.com](mailto:mbader@sheppardmullin.com)

Ericka Schulz  
[eschulz@sheppardmullin.com](mailto:eschulz@sheppardmullin.com)

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PATENT OWNER:

Cyrus Morton  
[cmorton@robinskaplan.com](mailto:cmorton@robinskaplan.com)

Ryan Schultz  
[rschultz@robinskaplan.com](mailto:rschultz@robinskaplan.com)