

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TCL ELECTRONICS HOLDINGS LTD. and TCL INDUSTRIES
HOLDINGS CO., LTD.,
Petitioner,

v.

INTELLECTUAL VENTURES I, LLC,
Patent Owner.

IPR2024-01244
Patent 7,623,439 B2

Before JAMESON LEE, LARRY J. HUME,
and AMBER L. HAGY, *Administrative Patent Judges*.

LEE, *Administrative Patent Judge*.

DECISION
Denying Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

TCL Electronics Holdings Ltd. and TCL Industries Holdings Co., Ltd. (collectively “Petitioner”) filed a Petition requesting an *inter partes* review of claims 1–21 (“challenged claims”) of U.S. Patent No. 7,623,439 B2 (Ex. 1001, “the ’439 patent”). Paper 1 (“Pet.”). Intellectual Ventures I, LLC (“Patent Owner”) filed a Preliminary Response. Paper 6 (“Prelim. Resp.”).

We have authority to determine whether to institute an *inter partes* review. *See* 35 U.S.C. § 314 (2018); 37 C.F.R. § 42.4(a) (2024). An *inter partes* review may not be instituted unless the information presented in the Petition “shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” 35 U.S.C. § 314(a). The “reasonable likelihood” standard is “a higher standard than mere notice pleading” but “lower than the ‘preponderance’ standard to prevail in a final written decision.” *Hulu, LLC v. Sound View Innovations, LLC*, IPR2018-01039, Paper 29 at 13 (PTAB Dec. 20, 2019) (precedential).

Upon consideration of the contentions and the evidence of record before us, we conclude Petitioner has not shown a reasonable likelihood that it would prevail in establishing unpatentability of any claim of the ’439 patent. Accordingly, we decline to institute *inter partes* review.

II. BACKGROUND

A. *Real Parties in Interest*

Petitioner identifies TCL Electronics Holdings Ltd. and TCL Industries Holdings Co., Ltd. as real parties in interest. Pet. 78. Patent Owner identifies Intellectual Ventures I LLC as real party in interest. Paper 5, 2.

B. Related Matters

Both Petitioner and Patent Owner identify the following litigations as related matters:

Intellectual Ventures I LLC v. TCL Electronics Holdings Ltd. et al., No. 6:23-cv-00309 (W.D. Tex. April 26, 2023);

Intellectual Ventures I LLC et al. v. Lenovo Group Limited, No. 6:23-cv-307 (W.D. Tex. April 26, 2023);

Intellectual Ventures I LLC et al. v. OnePlus Technology (Shenzen) Co., Ltd., No. 6:23-cv-00290 (W.D. Tex. April 20, 2023); and

Intellectual Ventures I LLC et al. v. Zebra Technologies Corporation, No. 6:23-cv-00292 (W.D. Tex. April 20, 2023).

Pet. 78–79; Paper 5, 2.

Petitioner additionally identifies the following litigations as related matters:

Intellectual Ventures I LLC v. TP-Link Corp., No. 6:23-cv-00308 (W.D. Tex.);

Intellectual Ventures I LLC v. TP-Link Corp., No. 6:23-cv-291 (W.D. Tex.);

Intellectual Ventures I LLC v. Lenovo Grp. Ltd., No. 6:23-cv-00068 (W.D. Tex.); and

Intellectual Ventures I LLC v. Hewlett Packard Enterprise Co., No. 1:22-cv-01350 (D. Del.).

Intellectual Ventures I LLC v. TCL Electronics Holdings Ltd., No. 6:23-cv-00293 (W.D. Tex.);

Id. at 78–79.

Both Petitioner and Patent Owner identify IPR2024-00883 as an *inter partes* review proceeding involving the '439 patent. Pet. 78; Paper 5, 2. Additionally, IPR2024-01224 is another *inter partes* review proceeding involving the '439 patent.

C. *The '439 Patent*

The '439 patent is titled “Cyclic Diversity Systems and Methods.” Ex. 1001, code (54). It issued on November 24, 2009, from Application 11/121,661, filed May 4, 2005, which claims the benefit of Provisional Application 60/572,481, filed on May 20, 2004. *Id.* at codes (21), (22), (45), (60). Its disclosure is related to wireless communication systems and methods. *Id.* at 1:15–16.

The '439 patent describes that continued demand for data rates have resulted in advancement of communications system technology, such as the use of multiple antennas in a single device having transmitter and/or receiver functionality. Ex. 1001, 1:23–27. It also describes that in new systems using multiple-antenna devices, there is a need to consider legacy receivers, e.g., single-input, single output (SISO), orthogonal frequency division multiplex (OFDM) receivers. *Id.* at 1:27–32.

The '439 patent explains that the same signals transmitted from multiple antennas on a single transmitter device may follow multi-paths to the one antenna on a SISO receiver device. Ex. 1001, 1:40–42. It also explains that, normally, multi-path signals, resulting from reflections off objects in the environment or from multiple antennas, “can result in either partial or complete constructive interference or destructive interference of the same signals in a SISO receiver.” *Id.* at 1:42–46.

The '439 patent describes that a known mechanism to avoid or mitigate completely destructive interference from multi-path signals is to equip one of the multiple transmitting antennas with a time delay element or provide a delay through a baseband processing section of the multiple-

antenna(MA) transmitter device, and that this is called “linear delay diversity.” Ex. 1001, 1:46–55.

The ’439 patent further describes that another known technique to make MA transmitters compatible with legacy SISO receivers is referred to a “cyclic delay diversity.” Ex. 1001, 3:50–52. “With cyclic delay diversity, each tone or subcarrier is cyclically shifted (e.g., in the baseband processing portion of the MA transmitter device 102, FIG. 1) by a defined amount of samples, resulting in a circular shift of all the samples involved (e.g., 64 samples plus 16 samples of the data and guard interval, respectively).” *Id.* at 3:52–57. In that regard, Figure 5 of the ’439 patent is reproduced below:

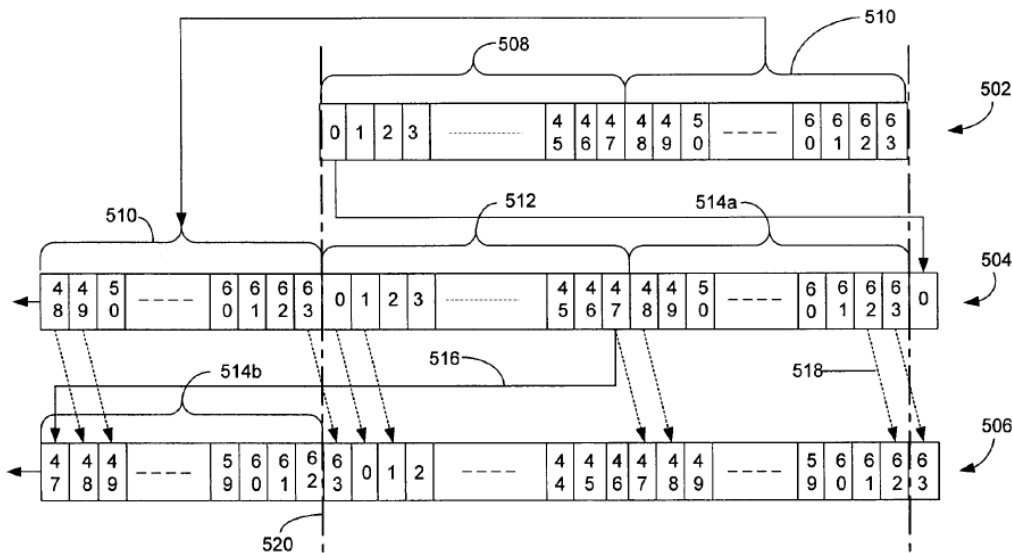


FIG. 5 (PRIOR ART)

Figure 5 is a schematic illustrating a 1-sample cyclic delay diversity. *Id.* at 5:3–4. The ’439 patent explains:

The first tier 502 represents 80 total samples comprising 64 samples of symbol data 508 and 16 samples that are used for a guard interval 510. The second tier 504 is simply an extension of the first tier, showing the guard interval 510 corresponding to samples 510 adjacent to the next set of samples. This next set of

samples comprises 64 samples of symbol data 512 and 16 samples corresponding to the guard interval 514a. The third tier 506 represents a 1-sample cyclic delay shift. As shown, a delay of one sample results in the guard interval 514b preceding the 80 sample symbol in the third tier 506, starting with sample [47], as indicated by line 516. All of the other samples are likewise shifted as represented by the dotted arrow-head lines 518.

From a receiver standpoint, the guard intervals 510, 514b remain aligned, as represented by the dashed line 520. In other words, with cyclic delay diversity, guard intervals are not consumed as they are in linear delay diversity. The samples used for each guard interval are different after a cyclic shift, but the guard intervals still remain as 16 samples.

Ex. 1001, 3:58–4:10.

As its invention, embodiments of cyclic diversity systems and methods are disclosed in the '439 patent. Ex. 1001, 4:26–27. Specifically, one embodiment comprises:

logic configured to *cyclically advance*, or the periodic equivalent, one or more sections of an orthogonal frequency division multiplexing (OFDM) packet relative to the OFDM packet to be transmitted on a first transmit antenna, the packet having the one or more cyclically advanced sections to be transmitted on a second transmit antenna, the duration of the cyclic advance having a duration less than a guard interval.

Id. at 4:27–34 (emphasis added). The '439 patent also describes, as its invention, a method embodiment “providing an orthogonal frequency division multiplexing (OFDM) packet corresponding to a first transmit antenna, and cyclically advancing, or the periodic equivalent, one or more sections of the OFDM packet corresponding to a second transmit antenna, the duration of the cyclic advance having a duration less than a guard interval.” *Id.* at 4:35–41.

The '439 patent discloses that “[b]y providing *cyclic advances*, cyclic shift diversity is employed which enables legacy receivers to experience improved packet error rate performance when compared to conventional diversity mechanisms, among other benefits.” Ex. 1001, 5:37–41 (emphasis added). The '439 patent further states that “[w]hat has been determined experimentally is that *small cyclic advances are superior to small cyclic delays*.” *Id.* at 8:21–23 (emphasis added).

The '439 patent additionally explains:

Due to the periodic nature of OFDM subcarriers, mathematically, a small cyclic advance of 100 nsec is identical or equivalent to a large delay of 3100 nsecs (the OFDM symbol waveform repeats with a period of 3.2 μ sec or 3200 nsec). In other words, 3100 nsec is a periodic equivalent to 100 nsec. Likewise, a small delay of 100 nsec is identical to an advance of 3100 nsec, again due to the periodic nature of the OFDM symbol 300 (e.g., FIG. 3). Thus, a signal received by the SISO receiver device 112 (FIG. 6) having a cyclic advance of 100 nsec or a signal having a cyclic delay of 3100 nsec is processed as an identical signal from the perspective of the SISO receiver device 112, since the EMA transmitter device 602 (FIG. 6) transmits the identical signal in each case. Since a circular shift is indeed circular, the FFT placement is at the same position shifting in either direction (100 nsec advance, 3100 nsec delay).

Ex. 1001, 8:5–21.

Figure 6 of the '439 patent is reproduced below:

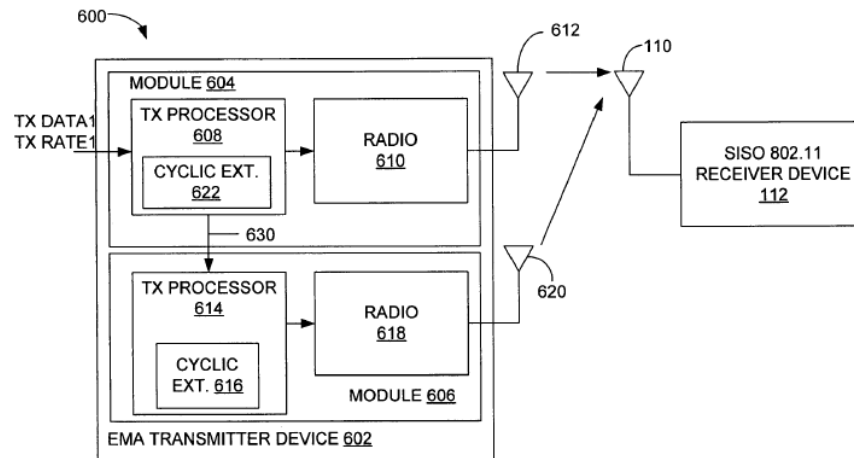


FIG. 6

Figure 6 of the '439 patent illustrates communication system 600 comprising an enhanced, multiple antenna (EMA) transmitter device and a SISO receiver device. Ex. 1001, 5:42–45. Communication system 600 comprises EMA transmitter device 602 and legacy receiver device 112. *Id.* at 5:45–47. The '439 patent describes:

The EMA transmitter device 602 and/or the SISO receiver device 112 may each be embodied in any wireless (e.g., radio frequency) communication device, including computers (desktop, portable, laptop, etc.), consumer electronic devices (e.g., multi-media players), compatible telecommunication devices, personal digital assistants (PDAs), or any other type of network devices, such as printers, fax machines, scanners, hubs, switches, routers, set-top boxes, televisions with communication capability, etc.

Id. at 5:64–6:5.

EMA transmitter device 602 comprises modules 604 and 606 and is compliant with 802.11 standards. Ex. 1001, 5:61–64. Module 604 comprises transmit (TX) processor 608 which includes baseband processing modules, i.e., logic, such as hardware and/or software, that includes

functionality for encoding, interleaving, mapping, and OFDM symbol generation and processing. *Id.* at 6:6–10.

Transmit processor 608 comprises cyclic extension module 622 that provides for cyclic extension (e.g., guard intervals) insertion and cyclic advance diversity. Ex. 1001, 6:10–14. The '439 patent states that in some embodiments, cyclic extension insertion may be implemented by a different module. *Id.* at 6:14–16. The '439 patent describes that cyclic extension module 622 may also provide for delay diversity (cyclic and/or linear) and that the delay or advance may be a switchable function. *Id.* at 6:16–18. Transmit processor 608 may deliver a cyclic advance in some transmissions, and may switch the functionality to deliver a cyclic (or linear) delay. *Id.* at 6:23–25. Module 604 further comprises radio circuitry 610 in communication with the transmit processor and antenna 612. *Id.* at 6:25–27.

Module 606 comprises similar components and functionality as module 604. Ex. 1001, 6:28–29. It includes transmit processor 614, radio circuitry 618, and antenna 620. *Id.* at 6:28–30. Transmit processor 614 further comprises a cyclic extension module 616 that operates in similar manner to cyclic extension module 622 of module 604. *Id.* at 6:30–32.

With respect to transmit processor 608 and 614, the '439 patent explains:

In operation, transmit processors 608 and 614 encode and interleave the incoming data (designated TX data1 at TX data rate1 at module 604, which is also provided to module 606 as represented by connection 630). Transmit processors 608 and 614 map the interleaved data into respective sub-carrier channels as frequency domain symbols. Inverse fast Fourier transform (IFFT) logic in baseband processing circuitry of the transmit processors 608 and 614 performs an inverse fast Fourier

transformation on the frequency domain symbols to create OFDM symbols.

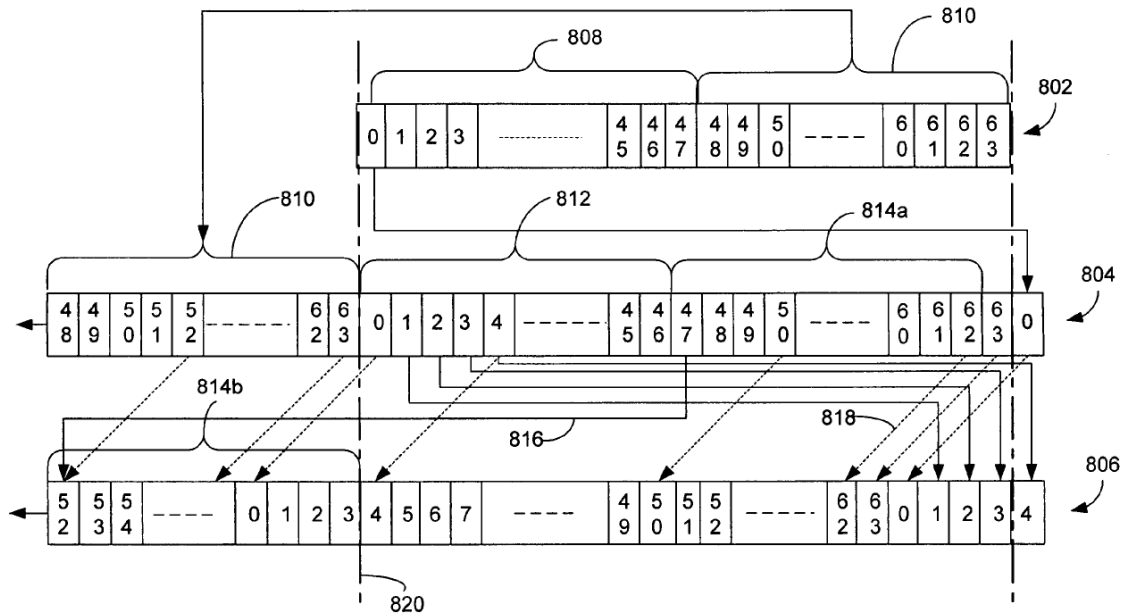
Ex. 1001, 6:42–51.

With reference to FIG. 6, the transmit processors 608 and 614 provide the processed data to radio circuitry 610 and 618, which provides such well-know[n] functions as filtering, modulation, amplification, and conversion (e.g., upconversion) functionality. The radio circuitry 610 and 618 provide the processed signals (e.g., no advance and no delay, and advanced, respectively) to antennas 612 and 620, from which the transmitted signals are delivered to SISO receiver device 112.

The signals transmitted from antennas 612 and 620 are received at antenna 110 of SISO receiver device 112, demodulated and converted to baseband, and processed to recover the transmitted data.

Id. at 7:18–30.

Figure 8 of the '439 patent is reproduced below:



'439 Patent – Fig. 8

Figure 8 illustrates 4-sample *cyclic advance diversity* as implemented by communication system 600 shown in Figure 6. Ex. 1001, 7:31–33. The '439 patent describes:

The first tier 802 represents 80 total samples comprising 64 samples of symbol data 808 and 16 samples that are used for a guard interval 810. The second tier 804 is simply an extension of the first tier 802, showing the guard interval corresponding to samples 810 adjacent to the next set of samples. This next set of samples comprises 64 samples of symbol data 812 and 16 samples corresponding to the guard interval 814a. The third tier 806 represents a 4-sample cyclic advance shift. As shown, an advance shift of 4 samples results in the guard interval 814b preceding the 80 sample symbol in the third tier 806 starting with sample [52], as represented by line 816. All of the other samples are likewise shifted as represented by the dotted arrow-head lines 818.

From a receiver standpoint, the guard intervals 810, 814b remain aligned, as represented by the dashed line 820. In other words, with cyclic advance diversity, and similar to cyclic delay diversity, guard intervals are not consumed as they are in linear delay diversity. However, unlike cyclic delay diversity, cyclic advance diversity does not result in net shifting of the FFT. That is, the FFT placement remains substantially centered and unshifted. One reason for this phenomenon is that the cyclic shifts created by the cyclic extension module 616 and 622 (FIG. 6) provide a shift that is in a direction opposite to any FFT shift that occurs in response to multi-path created by the multiple antennas and reflections.

Ex. 1001, 7:33–58.

Claims 1, 8, and 19 are independent and reproduced below:¹

¹ The bracketed headings correspond to those used by Petitioner to reference the claim elements. See Pet. 82–85. We use the same headings here for ease of reference, understanding, and consistency.

1. [preamble] A method for transmitting orthogonal frequency division multiplexing (OFDM) signals comprising:
 - [a][i] generating a first OFDM packet for transmission
 - [a][ii] including a guard interval portion and a symbol data portion each comprised of a plurality of samples;
 - [b][i] cyclically advancing the first OFDM packet by shifting the samples in a first direction
 - [b][ii] an amount less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission
 - [b][iii] in which at least a non-zero number of the samples from the symbol data portion of the first OFDM packet are shifted into the guard interval portion of the shifted version and a same non-zero number of samples from the guard interval portion of the first OFDM packet are shifted out of the guard interval portion of the shifted version; and
 - [c] substantially simultaneously transmitting the first OFDM packet and the shifted version of the OFDM packet.

Ex. 1001, 9:32–49.

8. [preamble] A signal transmitting system for transmitting orthogonal frequency division multiplexing (OFDM) signals comprising:
 - [a] a first transmit processor for generating a first OFDM packet for transmission including a guard interval portion and a symbol data portion each comprised of a plurality of samples;
 - [b] a second transmit processor for cyclically advancing the first OFDM packet by shifting the samples in a first direction an amount less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission in which at least a non-zero number of the samples from the symbol data portion of the first OFDM packet are shifted into the guard interval portion of the shifted version and a same non-zero number of the samples from the guard interval portion of the first OFDM packet are shifted out of the guard interval portion of the shifted version;

- [c] a plurality of radio transmitters for converting the OFDM packet and the shifted version of the OFDM packet to corresponding radio signals;
- [d] and a plurality of radio antennas correspondingly coupled to the plurality of radio transmitters for transmitting the radio signals;
- [e] wherein the first transmit processor and the second transmit processor are configured to substantially simultaneously cause the transmission of the first OFDM packet and the shifted version of the OFDM packet via corresponding transmitters and antennas.

Ex. 1001, 10:7–36.²

19. [preamble] A signal transmitting system for transmitting orthogonal frequency division multiplexing (OFDM) signals comprising:

- [a] means for generating a first OFDM packet for transmission including a guard interval portion and a symbol data portion each compromised of a plurality of samples:
- [b] means for cyclically advancing the first OFDM packet including a guard interval portion and a symbol data portion each compromised of a plurality of samples by shifting the samples in a first direction an amount less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission in which at least a non-zero number of the samples from the symbol data portion of the first OFDM packet are shifted into the guard interval portion of the shifted version and a same non-zero number of samples from the guard interval portion of the first OFDM packet are shifted out of the guard interval portion of the shifted version;

² The above-quoted claim 8 includes the correction made by a Certificate of Correction, dated November 24, 2009, which changed “die” to “the” in column 10, line 24 of the ’439 patent. Ex. 1001, 20.

[c] means for convening the first OFDM packet and the shifted version of the OFDM packet to corresponding radio signals;
and

[d] means for substantially simultaneously causing the transmission of the first OFDM packet and the shifted version of the OFDM packet.

Ex. 1001, 11:5–12:9.³

D. The Applied Prior Art and Declarations

Petitioner relies on the following evidence:

Name	Patent Document/Publication	Exhibit
Larsson ⁴	US Pat. No. 6,842,487 B1	1005
Bauch ⁵	WIPO International Pub. No. WO 2005/041441 A1	1007
Kaiser ⁶	Armin Dammann and Stefan Kaiser, <i>Low Complex Standard Comformable Antenna Diversity Techniques for OFDM Systems and its Application to the DVB-T System</i> , http://www.dlr.de/KN/KN-S	1006
IEEE	IEEE 802.11a-1999, Supplement to IEEE	1008

³ The word “compromised” in above-reproduced claim 19 appears to be a typographical mistake for the word “comprised.” The parties appear to have treated “compromised” as though it reads “comprised.” So do we, in light of the “comprised” wording in other claims and in the absence of a contrary position taken by either party. Similarly, the word “we” in above-reproduced claim 19 appears to be a typographical mistake for the word “are.” The parties appear to have treated it the same as the word “are.” So do we.

⁴ Issued January 11, 2005, from Application 09/667,504, filed September 22, 2000. Ex. 1005, codes (21), (22), (45).

⁵ Published May 6, 2005, from PCT/EP2003/010846, filed September 30, 2003. Ex. 1007, codes (21), (22), (43).

⁶ According to Petitioner, Kaiser is “a conference paper from the 2002 International ITG Conference on Source and Channel Coding, held January 2002.” Pet. 2. Also, according to Petitioner, Kaiser was publicly available no later than March 31, 2003. *Id.* (citing Ex. 1015, 1–11).

Name	Patent Document/Publication	Exhibit
	Standard for Information technology — Telecommunications and Information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications: High-speed Physical Layer in the 5 GHZ Band. IEEE Standards, December 30, 1999.	

Petitioner relies on the Declaration of Nader Bagherzadeh, Ph.D. Ex. 1003. Petitioner also relies on an Affidavit of Nathaniel E. Frank-White, Records Request Processor at the Internet Archive, regarding the date of publication of Kaiser. Ex. 1015. Patent Owner relies on the Declaration of Gary Lomp, Ph.D. Ex. 2001.

E. The Asserted Grounds of Unpatentability

Petitioner asserts that the challenged claims of the '439 patent are unpatentable based on the following grounds (Pet. 3):

Claims Challenged	35 U.S.C. §	Reference(s)/Basis
1–21	103(a) ⁷	Larsson, IEEE
1–21	103(a)	Kaiser, Bauch, IEEE

⁷ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112–29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. §§ 102 and 103. Because the '439 patent issued from an application which was filed before March 16, 2013 (the effective date of the amendments), the pre-AIA version of § 103 applies.

III. ANALYSIS

A. *Legal Standards*

A claim is unpatentable under 35 U.S.C. § 103(a) “if the differences between the subject matter sought to be patented 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.” 35 U.S.C. § 103(a); *see KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) where in evidence, so-called secondary considerations of nonobviousness.⁸ *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

B. *Level of Ordinary Skill in the Art*

Petitioner asserts a person of ordinary skill in the art (hereinafter “POSITA”) “would have at least a Bachelor’s degree in electrical engineering, computer engineering, computer science, or a related field, with at least two or more years of experience in the field of wireless communication systems and protocols, with more education substituting for work experience and vice versa.” Pet. 7 (citing Ex. 1003 ¶ 31). Patent Owner does not make any averment with respect to the level of ordinary skill in the art and also does not dispute Petitioner’s assertion regarding the level of ordinary skill in the art. *See generally* Prelim. Resp.

⁸ The record does not include any evidence of objective indicia of nonobviousness.

On this record, and for purposes of this Decision on whether to institute review, we adopt Petitioner’s statement of the level of ordinary skill in the art, except that we eliminate the modifier “at least” as applied to the level of education and as applied to the amount of experience. The inclusion of the modifier “at least” renders the articulation over-inclusive by encompassing a level of education way higher than that of a Bachelor’s degree and a level of experience way more than two years, inclusive of the education and experience of an expert.

C. Claim Interpretation

We use the same claim construction standard that would be used to construe a claim in a civil action under 35 U.S.C. § 282(b), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent. 37 C.F.R. § 42.100(b). The claim construction standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc) is applicable.

Claim terms are generally given their ordinary and customary meaning as would be understood by one with ordinary skill in the art in the context of the specification, the prosecution history, other claims, and extrinsic evidence including expert and inventor testimony, dictionaries, and learned treatises, although extrinsic evidence is less significant than the intrinsic record. *Phillips*, 415 F.3d at 1312–17. Usually, the specification is dispositive, and it is the single best guide to the meaning of a disputed term. *Id.* at 1315.

The specification may reveal a special definition given to a claim term by the patentee, or the specification or prosecution history may reveal an

intentional disclaimer or disavowal of claim scope by the inventor. *Phillips*, 415 F.3d at 1316. “There are only two exceptions to this general rule:

1) when a patentee sets out a definition and acts as his own lexicographer, or
2) when the patentee disavows the full scope of a claim term either in the specification or during prosecution.” *Thorner v. Sony Comput. Ent. Am. LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012).

If an inventor acts as his or her own lexicographer, the definition must be set forth in the specification with reasonable clarity, deliberateness, and precision. *Renishaw PLC v. Marposs Societa’ per Azioni*, 158 F.3d 1243, 1249 (Fed. Cir. 1998). The disavowal, if any, can be effectuated by language in the specification or the prosecution history. *Poly-Am., L.P. v. API Indus., Inc.*, 839 F.3d 1131, 1136 (Fed. Cir. 2016).

Only those claim terms that are in controversy need to be construed, and only to the extent necessary to resolve the controversy. *Realtime Data, LLC v. Iancu*, 912 F.3d 1368 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

1. “*cyclically advancing the first OFDM packet by shifting the samples in a first direction*”

The term “cyclically advancing the first OFDM packet by shifting the samples in a first direction” appears in each of independent claims 1 and 8. Ex. 1001, 9:37–38, 10:14–16. Claim 19 recites the same but adds additional words within the term: “cyclically advancing the first OFDM packet *including a guard interval portion and a symbol data portion each compromised of a plurality of samples* by shifting the samples in a first direction.” *Id.* at 11:11–14 (emphasis added). Petitioner states:

A court in W.D. Tex. construed the term “cyclically advancing the first OFDM packet by shifting the samples in a first direction” as “cyclically advancing the first OFDM packet by shifting the samples in the direction of transmission.” See EX1009 at 8. Although that construction was adopted in a different case, Petitioners and Patent Owner agreed in their Joint Claim Construction Statement in the parallel litigation (the “Texas Litigation” as defined below) that this construction is appropriate. See EX1010.

Pet. 7–8. Patent Owner in the Patent Owner Response does not express any view with regard to a construction for this term.

We agree with what the parties agreed to in related litigation, because in the context of the disclosure of the ’439 patent disclosure, “delay” and “advance” are used relative to signal transmission via an antenna.

See Ex. 1001, 1:42–55, 3:50–4:41, 8:5–21. Accordingly, “cyclically advancing the first OFDM packet by shifting the samples in a first direction” means “cyclically advancing the first OFDM packet by shifting the samples in the direction of transmission.”

2. *Whether the first step must occur before the second step*

Petitioner asserts:

In the Texas Litigation, Petitioners have contended that the first step in Claim 1 (“generating a first OFDM packet . . .”) must occur before the second step (“cyclically advancing the first OFDM packet . . .”). See EX1010 at 2. Patent Owner disputes this construction. The prior art satisfies both parties’ constructions of this term, however, so the Board need not reach this dispute.

Pet. 8 (footnote omitted). Petitioner asserts that the same applies to claims 8 and 19 as well, based on corresponding limitations in those claims regarding performance of recited functions. *Id.*, at n.5. Petitioner does not indicate clearly whether it asserts the same construction in this proceeding. Patent

Owner does not express any view in this regard. Our Decision does not require a determination of the question whether generating a first OFDM packet must occur prior to cyclically advancing the OFDM packet.

Therefore, we do not reach the issue here.

3. *Various means-plus-function recitations in claim 19*

Claim 19 is reproduced here again, for ease of reference.

19. [preamble] A signal transmitting system for transmitting orthogonal frequency division multiplexing (OFDM) signals comprising:

[a] means for generating a first OFDM packet for transmission including a guard interval portion and a symbol data portion each compromised of a plurality of samples:

[b] means for cyclically advancing the first OFDM packet including a guard interval portion and a symbol data portion each compromised of a plurality of samples by shifting the samples in a first direction an amount less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission in which at least a non-zero number of the samples from the symbol data portion of the first OFDM packet we shifted into the guard interval portion of the shifted version and a same non-zero number of samples from the guard interval portion of the first OFDM packet are shifted out of the guard interval portion of the shifted version;

[c] means for convening the first OFDM packet and the shifted version of the OFDM packet to corresponding radio signals;
and

[d] means for substantially simultaneously causing the transmission of the first OFDM packet and the shifted version of the OFDM packet.

Ex. 1001, 11:5–12:9.⁹

⁹ The word “compromised” in above-reproduced claim 19 appears to be a typographical mistake for the word “comprised.” The parties appear to have

Petitioner proposes the following constructions for the various means-plus-function elements in claim 19.

Means-Plus-Function Element	Corresponding Structure	Function Performed
19[a]	Transmit processor performing the algorithm disclosed in the 802.11 standard	Generating a first OFDM packet for transmission including a guard interval portion and a symbol data portion each compromised of a plurality of samples
19[b]	Transmit processor performing the algorithm disclosed in elements 804-806 of Figure 8 of the '439 Patent	Cyclically advancing the first OFDM packet including a guard interval portion and a symbol data portion each compromised of a plurality of samples by shifting the samples in a first direction an amount less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission in which at least a non-zero number of the samples

treated “compromised” as though it reads “comprised.” So do we, in light of the “comprised” wording in other claims and in the absence of a contrary position taken by either party. Similarly, the word “we” in above-reproduced claim 19 appears to be a typographical mistake for the word “are.” The parties appear to have treated it the same as the word “are.” So do we.

Means-Plus-Function Element	Corresponding Structure	Function Performed
		from the symbol data portion of the first OFDM packet we shifted into the guard interval portion of the shifted version and a same non-zero number of samples from the guard interval portion of the first OFDM packet are shifted out of the guard interval portion of the shifted version
19[c]	Radio transmitter performing the algorithm disclosed in the 802.11 standard	Converting the first OFDM packet and the shifted version of the OFDM packet to corresponding radio signals
19[d]	Transmit processors performing the algorithm disclosed in the 802.11 standard	Substantially simultaneously causing the transmission of the first OFDM packet and the shifted version of the OFDM packet

Pet. 8–9. Patent Owner has not expressed any position with regard to the construction of these means-plus-function elements in claim 19. Nor has Patent Owner disputed these proposed constructions of Petitioner.

We agree with Petitioner that limitations 19[a], 19[b], 19[c], and 19[d] are means-plus-function elements under 35 U.S.C. § 112, sixth paragraph, and we have no reason to disagree with Petitioner’s identification of corresponding structure in the ’439 patent’s specification. We adopt

Petitioner's statement of construction for these means-plus-function elements.

D. Alleged Obviousness of Claims 1–21 over Larsson and IEEE

1. Overview of Larsson (Exhibit 1005)

Larsson is a U.S. Patent titled “Cyclic Delay Diversity for Mitigating Intersymbol Interference in OFDM Systems.” Ex. 1005, code (54). It states: “The present invention is directed to transmission diversity, and more specifically to mitigating ISI [Intersymbol Interference] by employing a cyclic delay in a transmission diversity system.” *Id.* at 6:26–28.

Figure 8 of Larsson is reproduced below:

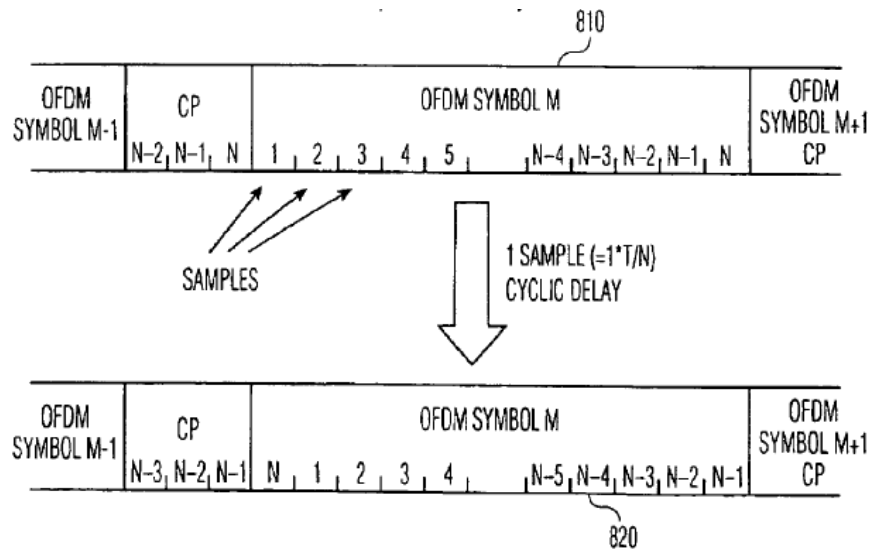


FIG. 8

Figure 8 illustrates two OFDM symbols wherein there is a cyclic delay between the two symbols in accordance with exemplary embodiments of Larsson. Ex. 1005, 5:65–67. Larsson describes:

FIG. 8 illustrates two OFDM symbols wherein a cyclic delay is implemented between the two symbols being transmitted in a transmission diversity scheme. Assume that OFDM symbol M

810 is transmitted over the antenna that has no cyclic delay and that OFDM symbol M 820 is transmitted over an antenna which has a cyclic delay of one sample. As can be seen by comparing OFDM symbols 810 and 820, the cyclic delay is implemented by shifting samples from the end of the OFDM symbol into the beginning of the OFDM symbol and adding a cyclic prefix by copying the last *n* samples of the OFDM symbol. For example, if a cyclic delay of three samples were implemented, the OFDM symbol transmitted over the third antenna would have the last three samples of the OFDM symbol shifted into the first three slots of the OFDM symbol and the remaining samples in the OFDM symbol would be shifted three places to the right. Then the last *n* samples of the OFDM symbol are copied and placed in the cyclic prefix, wherein *n* represents the number of samples in the cyclic prefix for a particular system.

Id. at 6:39–57.

2. *Overview of IEEE (Exhibit 1008)*

IEEE is an amendment to IEEE Standard 802.11-1999. Ex. 1008, 1. “Changes and additions to IEEE Std. 802.11-1999 are provided to support the new highrate physical layer (PHY) for operation in the 5 GHz band.” *Id.* Clause 17 is added to the base standard. *Id.* at 15. Regarding Clause 17, IEEE states: “This clause specifies the PHY entity for an orthogonal frequency division multiplexing (OFDM) system and the additions that have to be made to the base standard to accommodate the OFDM PHY.” *Id.*

3. *Independent Claim 1*

We find below that Petitioner has not set forth sufficient reasoning as to why Larsson discloses limitation 1[b][ii], for which Petitioner relies solely on Larsson’s disclosure. We first discuss Petitioner’s contentions for the preamble of claim 1 and limitations 1[a][i] and 1[a][ii]. Then we discuss Petitioner’s assertions for limitation 1[b][i] of claim 1, Patent Owner’s counter-arguments with regard to limitation 1[b][i], and why Petitioner has

made an adequate showing for limitation 1[b][i]. Thereafter, we explain why Petitioner’s accounting for limitation 1[b][ii] is misplaced and unpersuasive even for purposes of institution of review.

a. Preamble Recitation — 1[preamble]

The preamble recites: “A method for transmitting orthogonal frequency division multiplexing (OFDM) signals comprising.” Ex. 1001, 9:32–33. Petitioner asserts Larsson’s Figure 9 shows multiple OFDM signals being transmitted. Pet. 13. Petitioner also asserts that Larsson teaches a specific method by which those OFDM signals are generated and transmitted. *Id.* (citing Ex. 1005, 6:58–60). Patent Owner does not dispute Petitioner’s assertions.

b. Limitation 1[a][i]

Limitation 1[a][i] recites: “generating a first OFDM packet for transmission.” Ex. 1001, 9:34. Petitioner asserts “Larsson teaches this limitation.” Pet. 14 (citing Ex. 1003 ¶¶ 76–77). As illustration, Petitioner reproduces Larsson’s Figure 9:

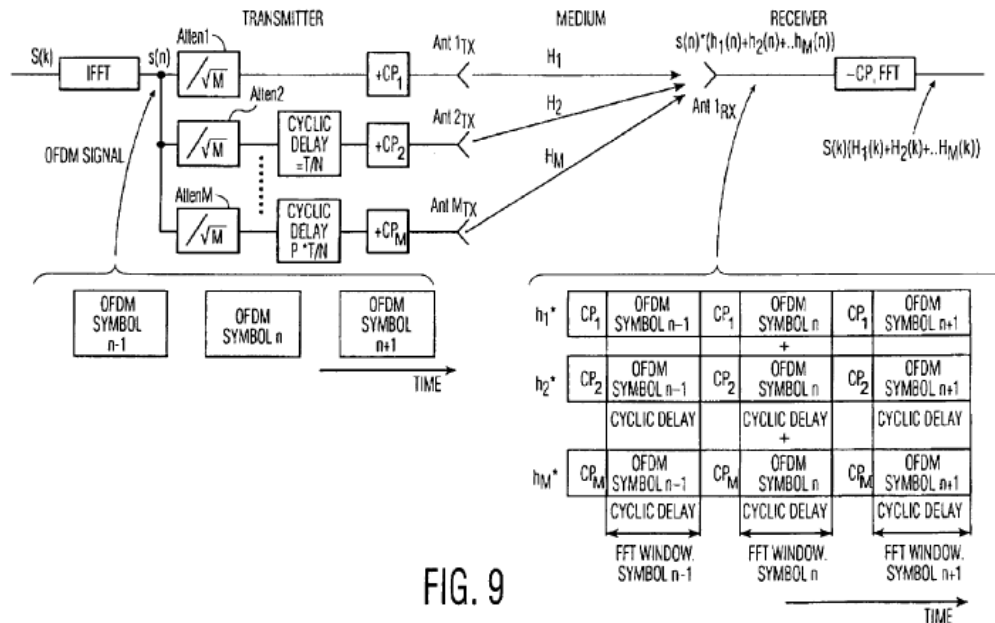


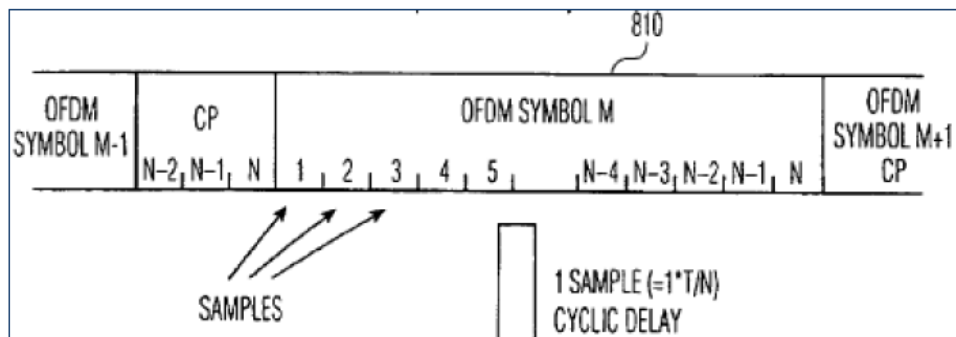
FIG. 9

Pet. 14. Larsson's Figure 9 illustrates a transmitter and receiver employing a cyclic delay. Ex. 1005, 6:1–3. Petitioner states that Larsson's Figure 9 "depicts OFDM packets (*e.g.*, OFDM symbol *n*) that are illustrated as leaving from the TRANSMITTER through a MEDIUM to the RECEIVER, such that the first OFDM packet is for transmission." Pet. 14. Patent Owner does not dispute Petitioner's assertions.

c. Limitation 1[a][ii]

Limitation 1[a][ii] recites: "including a guard interval portion and a symbol data portion each comprised of a plurality of samples." Ex. 1001, 9:34–36. It modifies the OFDM packet recited in limitation 1[a][i]. *Id.*

Petitioner asserts "Larsson teaches this limitation." Pet. 14 (citing Ex. 1003 ¶¶ 78–79). As support, Petitioner produces the following partial portion (top half showing a OFDM symbol without a delay) of Larsson's Figure 8:



Pet. 15. Figure 8 of Larsson illustrates two OFDM symbols with a cyclic delay between them. Ex. 1005, 5:65–67. The identifier "CP" represents "cyclic prefix" or a "guard interval." *Id.* at 1:31–32. Petitioner explains: "As Larsson teaches and a POSITA [person of ordinary skill in the art] would recognize, the OFDM SYMBOL M portion corresponds to the symbol data portion because it is not the guard interval/ cyclic prefix and is

instead the useful data signal. *See id.* at, e.g., 5:11–13 (explaining that the OFDM symbol portions are ‘usable bandwidth . . . for transmission of data’); EX1003 ¶79.” Pet. 15. Patent Owner does not dispute Petitioner’s assertions.

d. Limitation 1[b][i]

Limitation 1[b][i] recites: “cyclically advancing the first OFDM packet by shifting the samples in a first direction.” Ex. 1001, 9:37–38.

Petitioner explains:

Larsson teaches this limitation. *See* EX1003 ¶80-81. While Larsson primarily discusses cyclic delay of the first OFDM packet by shifting the samples in a direction (in Figure 8, for example), *Larsson teaches cyclical shifting in either direction*:

Although exemplary embodiments of the present invention are described above as implementing cyclic delay by shifting samples from the end of an OFDM symbol into the beginning of the OFDM symbol, the present invention can also be implemented so that the samples from the beginning of the OFDM symbol are shifted into the end of the OFDM symbol.

See EX1005 at 9:41–47. *Larsson refers to a shift in the first direction described above as a cyclic delay, so a POSITA would recognize that a shift in the opposite direction is a cyclic advance. See* EX1003 ¶82. A POSITA would understand that a cyclic delay is a shift in the opposite direction as the signal transmission direction (which is what makes it a delay), so a cyclic advance is necessarily a shift in the direction of signal transmission. *See id.* ¶¶35, 82.

Pet. 15–16 (emphasis added) (footnote omitted) (citing Ex. 1005, 6:46–48 (“[T]he cyclic delay is implemented by shifting samples from the end of the OFDM symbol into the beginning of the OFDM symbol and adding a cyclic prefix by copying the last n samples of the OFDM symbol.”)).

Patent Owner disagrees. According to Patent Owner:

Larsson's disclosure was limited to small cyclic delays (e.g., a 1-sample delay and a 3-sample delay). Ex. 2001, ¶65. The fact that Larsson was singularly focused on cyclic delays is evident from both the title of Larsson ("Cyclic Delay Diversity for . . .") and the first sentence of the "Detailed Description" of Larsson:

DETAILED DESCRIPTION

The present invention is directed to transmission diversity, and more specifically to mitigating ISI by employing a cyclic delay in a transmission diversity system. Ex. 1005, 6:25-28 (emphasis added).

Ex. 1005, 6:25-28 (emphasis added). The figures and text of Larsson recite the term "cyclic delay" 73 times, in connection with every embodiment. Ex. 1005, 6:39-50 ("FIG. 8 illustrates two OFDM symbols wherein a cyclic delay is implemented . . . the cyclic delay is implemented by shifting samples from the end of the OFDM symbol into the beginning . . . For example, if a cyclic delay of three samples were implemented . . ."); 7:8-9 ("Each subsequent antenna path performs the cyclic delay on the symbol"); 7:23-24 ("the cyclic delay is converted into a phase factor"); 7:28-31 ("FIG. 9 illustrates a cyclic delay for a transmit diversity scheme, it can be seen that the cyclic delay is not limited by the size of the cyclic prefix"); 7:34-36 ("a system which uses a cyclic delay is only limited to using a number of antennas equal to the number of samples in the OFDM symbol. Further, by using a cyclic delay . . ."); 7:39-42 ("Curve 1010 illustrates the power carrier density function for the transmission using a cyclic delay of . . . As illustrated in FIG. 10, the implementation of a cyclic delay results in . . ."); 7:48-50 ("FIG. 11 illustrates the subcarrier covariance matrix for a transmission diversity system which employs 32 cyclic delays"); 7:57-58 ("FIG. 12 illustrates an exemplary method for employing cyclic delay in accordance with the present invention"; and 9:4-5 ("As can be seen from FIGS. 13B and 13C, the cyclic delays t_1 , t_2 , and t_3 are chosen such . . ."). Ex. 2001, ¶66.

Prelim. Resp. 25–26.

Patent Owner's arguments do not undermine Petitioner's showing for limitation 1[b][i]. No matter how numerous are the mentioning in Larsson of performing a cyclic delay and no matter how Larsson is titled, so long as Larsson discloses a single instance of performing a cyclic advance of the OFDM packet by shifting the samples in a first direction, Larsson discloses limitation 1[b][i]. Petitioner sufficiently has shown such an instance.

Petitioner's expert, Dr. Bagherzafteh, explains:

While Larsson primarily discusses cyclic delay of the first OFDM packet by shifting the samples in a direction (in Figure 8, for example), Larsson teaches cyclical shifting in either direction:

Although exemplary embodiments of the present invention are described above as implementing cyclic delay by shifting samples from the end of an OFDM symbol into the beginning of the OFDM symbol, **the present invention can also be implemented so that the samples from the beginning of the OFDM symbol are shifted into the end of the OFDM symbol.**

See id. at 9:41–47 (emphasis added). Larsson refers to a shift in the first direction described above as a cyclic delay, so a POSITA would recognize that a shift in the opposite direction is a cyclic advance.

Ex. 1003 ¶ 81 (cited at Pet. 15). We credit this testimony of Dr. Bagherzafteh. Nothing presented by Patent Owner undermines the above-noted analysis of Petitioner and its expert.

Patent Owner argues the following with regard to the passage in Larsson referred to by Petitioner as disclosing shifting in either direction, i.e., Ex. 1005, 9:41–47:

This passage is stating that there are two ways to implement the cyclic delay employed in the present invention: one way of implementing the cyclic delay (described in

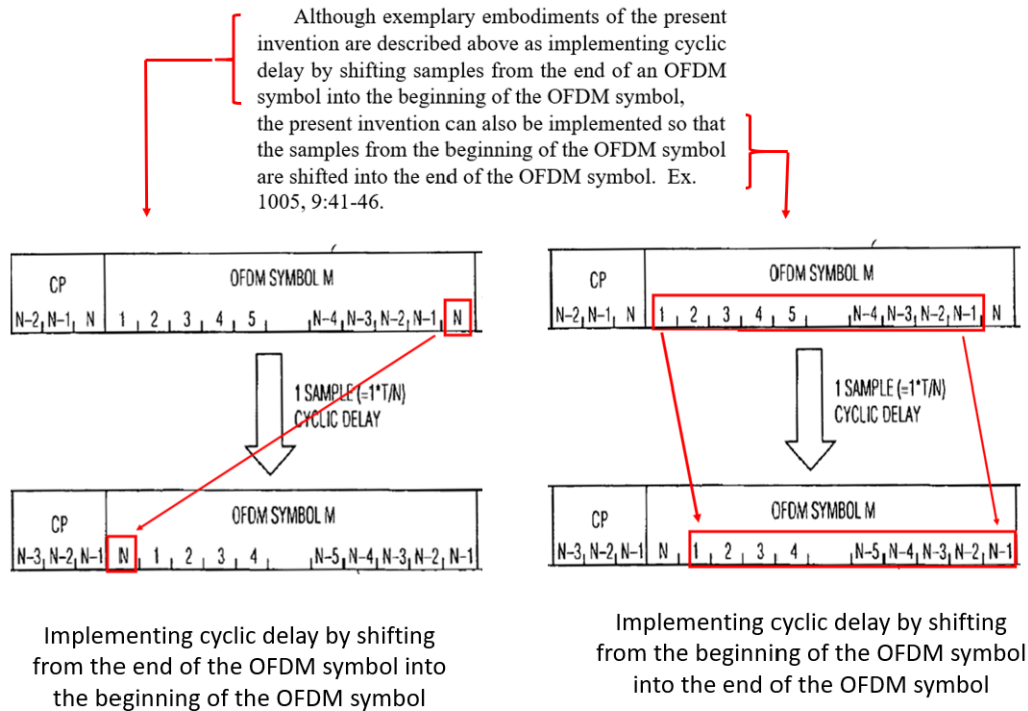
connection with, e.g., FIG. 8) is to shift samples from the end of an OFDM symbol into the beginning of the OFDM symbol, and the second way of implementing the cyclic delay is by shifting “samples from the beginning of the OFDM symbol . . . into the end of the OFDM symbol.” Ex. 2001, ¶67.

Prelim. Resp. 27. This argument is supported by the cited testimony of Dr. Lomp but does not undermine Petitioner’s reasoning. According to the ’439 patent, a small cyclic advance is identical or equivalent to a large cyclic delay, and a small cyclic delay is identical or equivalent to a large cyclic advance, because the OFDM symbol repeats periodically. Ex. 1001, 8:5–21. Specifically, the ’439 patent states:

Due to the periodic nature of OFDM subcarriers, mathematically, a small cyclic advance of 100 nsec is identical or equivalent to a large delay of 3100 nsecs (the OFDM symbol repeats with a period of 3.2 μ sec or 3200 nsec). In other words, 3100 nsec is a periodic equivalent to 100 nsec. Likewise, *a small delay of 100 nsec is identical to an advance of 3100 nsec, again due to the periodic nature of the OFDM symbol 300* (e.g., FIG. 3). Thus, *a signal received by the SISO receiver device 112 (FIG. 6) having a cyclic advance of 100 nsec or a signal having a cyclic delay of 3100 nsec is processed as an identical signal from the perspective of the SISO receiver device 112*, since the EMA transmitter device 602 (FIG. 6) transmits the identical signal in each case. Since a circular shift is indeed circular, the FFT placement is at the same position shifting in either direction (100 nsec advance, 3100 nsec delay).

Id. (emphasis added). Thus, because of the periodic nature of OFDM carriers, a small cyclic delay is the same as a relatively large cyclic advance. Hence, Larsson provides two ways of implementing a cyclic delay, one representing a delay, and the other an advance that is identical or equivalent to that delay.

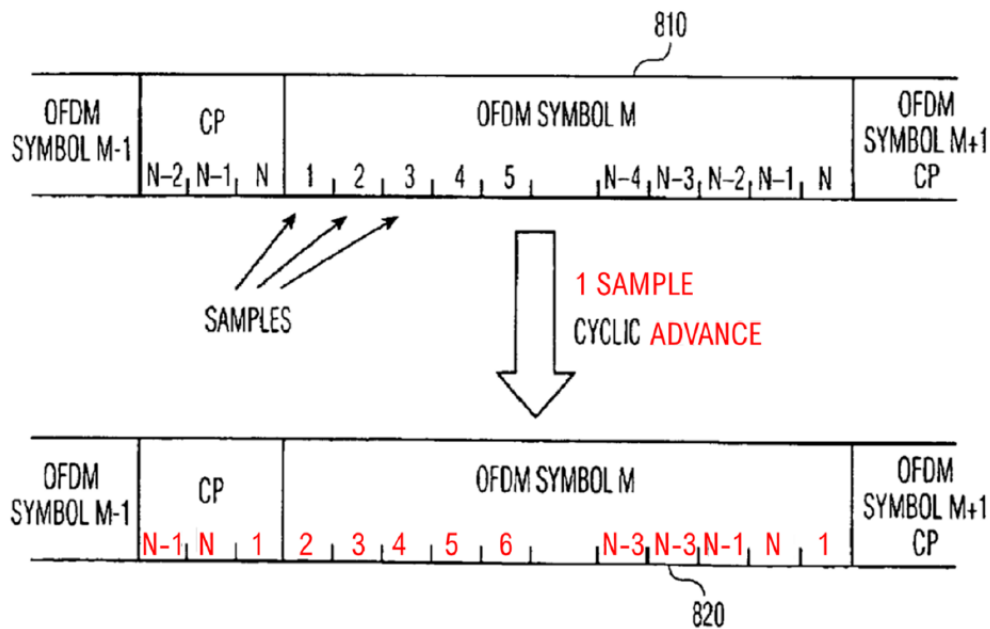
Even Patent Owner's illustration confirms Larsson's disclosure of a cyclic advance. Patent Owner produces the following diagram to illustrate the two ways Larsson discloses for implementing a cyclic delay:



Prelim. Resp. 27. According to Patent Owner, the left half of the illustration is “implementing cyclic delay by shifting from the end of the OFDM symbol into the beginning of the OFDM symbol”; the right half of the illustration is “implementing cyclic delay by shifting from the beginning of the OFDM symbol into the end of the OFDM symbol”; and both result in a 1-sample “cyclic delay.” *Id.* Because of the opposite directions of sample shifting, one approach represents a delay and the other represents an advance, even though both result in the equivalent of a 1-sample cyclic delay. Patent Owner does not dispute that shifting samples in a direction opposite to that corresponding to a delay constitutes an advance. The 1-sample cyclic delay

shown on the right side of the illustration is identical to a cyclic advance of an unspecified magnitude shown on the left side of the illustration.

Patent Owner further provides an illustration of a 1-sample cyclic advance as applied to an OFDM symbol according to Larsson, to show that it is different from Petitioner’s reliance on Larsson’s disclosure of a 1-sample cyclic delay:



Prelim. Resp. 28. The illustration is Patent Owner’s depiction of a 1-sample cyclic advance as applied to Larsson’s OFDM symbol. *Id.* This depiction shows a difference between a 1-sample cyclic advance from the 1-sample cyclic delay presented by Patent Owner above. Patent Owner asserts that “Larsson did not disclose (or even suggest) the small cyclic advance claimed in the ‘439 patent.” *Id.* (citing Ex. 2001 ¶ 68).

Patent Owner’s argument is misplaced and inconsequential in the context of limitation 1[b][i], which has no requirement for the length of the recited cyclic advance. For limitation 1[b][i], Petitioner has not asserted that the cyclic advance applied in one of the two disclosed approaches for

achieving a 1-sample cyclic delay is a 1-sample cyclic advance. An advance of any sample size is sufficient to meet limitation 1[b][i].

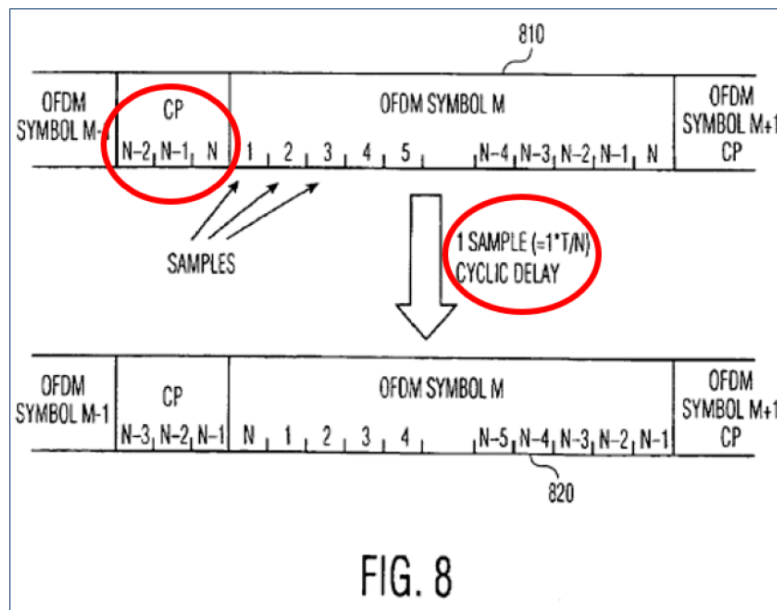
For the foregoing reasons, Petitioner sufficiently has shown that Larsson discloses limitation 1[b][i].

e. Limitation 1[b][ii]

Limitation 1[b][ii] further modifies the cyclic advance recited in limitation 1[b][i] by requiring that the cyclic advance be “an amount less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission.” Ex. 1001, 9:38–41.

Petitioner asserts:

Larsson teaches this limitation. See EX1003 ¶82. Larsson’s Figure 8, for example, “illustrates two OFDM symbols wherein a cyclic” shift is implemented relative to the first OFDM packet to generate a shifted version of the first OFDM packet for transmission. See EX1005 at 6:39-49; EX1003 ¶82. Larsson teaches that this cyclic shift is just “1 SAMPLE” long, while Larsson’s guard interval (CP) is illustrated as being three samples long:



See EX1005 at Fig. 8 (annotated). [Figure 8 illustrates two OFDM symbols with a cyclic delay between them. Ex. 1005, 5:65–67; Petitioner has circled in red the cyclic prefix portion “CP” and the designation of a 1-sample “cyclic delay”] The 1-sample cyclic shift is less than the 3-sample duration illustrated. This shift generates the shifted version of the first OFDM packet (bottom half of Figure 8), and the shifted version (as well as the unshifted version) is for transmission because Figure 8 represents “two OFDM symbols . . . being transmitted.” *See id.* at 6:39–41; EX1003 ¶82.

Pet. 16–17.

Petitioner’s reasoning is misplaced and unpersuasive. Per limitation 1[b][ii], which modifies limitation 1[b][i], it is the cyclic advance in limitation 1[b][i] that must be “an amount less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission.” Ex. 1001, 9:37–41. Petitioner has shown the amount of the 1-sample delay in Larsson’s Figure 8 is “an amount less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission.” But that is not what is required by the claim. Petitioner has not shown the amount of the cyclic advance relied upon by Petitioner to satisfy the cyclic advance requirement of limitation 1[b][i] meets the duration requirement of limitation 1[b][ii].

Petitioner has not shown or even attempted to show that a cyclic advance is the same as a cyclic delay of the same amount.

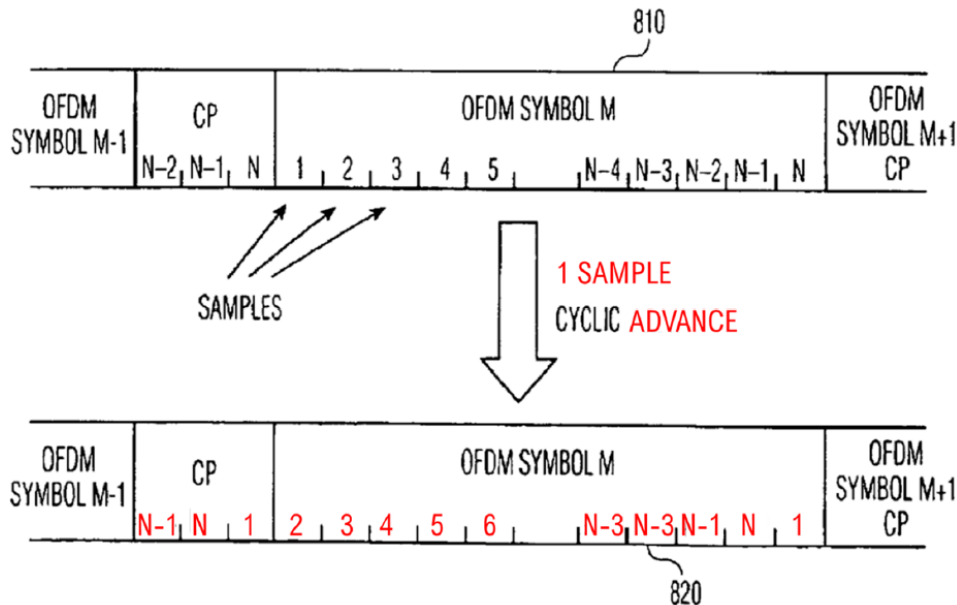
Further, that is not true according to the disclosure of the ’439 patent, which states:

Due to the periodic nature of OFDM subcarriers, mathematically, a small cyclic advance of 100 nsec is identical or equivalent to a large delay of 3100 nsecs (the OFDM symbol repeats with a period of 3.2 μ sec or 3200 nsec). In other words, 3100 nsec is a periodic equivalent to 100 nsec. Likewise, a small delay of 100

nsec is identical to an advance of 3100 nsec, again due to the periodic nature of the OFDM symbol 300 (e.g., FIG. 3). Thus, a signal received by the SISO receiver device 112 (FIG. 6) having a cyclic advance of 100 nsec or a signal having a cyclic delay of 3100 nsec is processed as an identical signal from the perspective of the SISO receiver device 112, since the EMA transmitter device 602 (FIG. 6) transmits the identical signal in each case. Since a circular shift is indeed circular, the FFT placement is at the same position shifting in either direction (100 nsec advance, 3100 nsec delay).

Ex. 1001, 8:5–21. Petitioner has not explained the amount of cyclic advance employed to achieve the 1-sample cyclic delay of Larsson’s Figure 8 and, consequently, Petitioner has not shown that that amount of cyclic advance is “less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission” as required by limitation 1[b][ii].

Further, Dr. Gary Lomp, Patent Owner’s expert, provides an illustration of a 1-sample cyclic advance for Larsson’s symbol in Figure 8:



The illustration is Dr. Lomp's depiction of a 1-sample cyclic advance of Larsson's symbol in Figure 8. Ex. 2001 ¶68. We credit this illustration by Dr. Lomp. It is not the same as the 1-sample cyclic delay shown in Larsson's Figure 8.

For the foregoing reasons, Petitioner has not sufficiently shown that Larsson, with or without reliance upon the IEEE reference, discloses or suggests limitation 1[b][ii].

f. Conclusion for Claim 1

Petitioner has not shown a reasonable likelihood that it would prevail in establishing obviousness of claim 1 over Larsson and IEEE.

4. Dependent Claim 2–7

Claims 2–7 each depend, directly or indirectly, from claim 1. Ex. 1001, 9:51–10:6. The deficiency of the Petition, as discussed above for claim 1, applies equally to claims 2–7. Petitioner has not shown a reasonable likelihood that it would prevail in establishing obviousness of any of claims 2–7 over Larsson and IEEE.

5. Independent Claim 8

Limitation 8[b] recites, in part, “a second transmit processor for *cyclically advancing the first OFDM packet by shifting the samples in a first direction an amount less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission . . .*” Ex. 1001, 10:14–18 (emphasis added). The italicized function of the second transmit processor is identical to the steps recited in limitations 1[b][i] and 1[b][ii]. For this feature, Petitioner relies on the same analysis it provides for limitations 1[b][i], 1[b][ii], and 1[b][iii]. Pet. 26–27.

For the same reasons Petitioner has not made a sufficient showing that Larsson, with or without IEEE, satisfies limitation 1[b][ii], Petitioner has not made a sufficient showing that Larsson, with or without IEEE, teaches or suggests this portion of limitation 8[b]: “a second processor for cyclically advancing the first OFDM packet by shifting the samples in a first direction an amount less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission.”

Petitioner has not shown a reasonable likelihood that it would prevail in establishing obviousness of claim 8 over Larsson and IEEE.

6. *Dependent Claim 9–18*

Claims 9–18 each depend, directly or indirectly, from claim 8. Ex. 1001, 10:37–11:4. The deficiency of the Petition, as discussed above for claim 8, applies equally to claims 9–18. Petitioner has not shown a reasonable likelihood that it would prevail in establishing obviousness of any of claims 9–18 over Larsson and IEEE.

7. *Independent Claim 19*

Limitation 19[b] recites, in part: “means for *cyclically advancing the first OFDM packet including a guard interval portion and a symbol data portion each compromised of a plurality of samples by shifting the samples in a first direction an amount less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission.*” Ex. 1001, 11:11–17 (emphasis added). The italicized function of the recited means is the same as the steps recited in limitations 1[a][ii], 1[b][i], and 1[b][ii]. For this feature, Petitioner relies on the same analysis it provides for limitation 8[b]. Pet. 39.

For the same reasons Petitioner has not made a sufficient showing that Larsson, with or without IEEE, satisfies limitation 8[b], Petitioner has not made a sufficient showing that Larsson, with or without IEEE, teaches or suggests this recited function of limitation 19[b]: “cyclically advancing the first OFDM packet including a guard interval portion and a symbol data portion each comprised of a plurality of samples by shifting the samples in a first direction an amount less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission.”

Petitioner has not shown a reasonable likelihood that it would prevail in establishing obviousness of claim 19 over Kaiser, Bausch, and IEEE.

8. Dependent Claims 20 and 21

Claims 20 and 21 each depend directly from claim 19. Ex. 1001, 12:10–19. The deficiency of the Petition, as discussed above for claim 19, applies equally to claims 20 and 21. Petitioner has not shown a reasonable likelihood that it would prevail in establishing obviousness of either claim 20 or 21 over Larsson and IEEE.

*E. Alleged Obviousness of Claims 1–21
Kaiser, Bausch, and IEEE*

1. Overview of Kaiser (Exhibit 1006)

Kaiser is a paper investigating antenna diversity concepts which can be applied to orthogonal frequency division multiplexing (OFDM) systems. Ex. 1006, Abstr. With respect to diversity techniques, Kaiser states: “[T]he main idea is to increase the frequency selectivity of the resulting channel transfer function by specific cyclic delays at the transmitter and/or receiver antennas.” *Id.* at 1. Kaiser introduces “Delay Diversity (DD), Cyclic Delay Diversity (CDD), Phase Diversity (PD) and Maximum Ratio Combining

(MRC), which can easily be applied to existing OFDM system standards with little efforts.” *Id.*

Kaiser describes:

The OFDM symbols of the CDD signal can be generated from the reference signal OFDM symbols just by applying a cyclic time shift of δ_{cy} to the reference signals’ OFDM symbols and subsequent insertion of the cyclic prefix.

* * *

Because of simple time shifts for DD resp. cyclic time shifts for CDD, these techniques are implementable with only slight additional complexity as long as the delays δ_n and $\delta_{cy n}$ are multiples of the system sampling time.

Ex. 1006, 2.

Kaiser describes the simulations it has performed applying cyclic delay to multiple antenna systems while using a single antenna system as a reference. Ex. 1006, 4–5. Kaiser also provides the results of its simulations. *Id.* at 5–6. Specifically, Kaiser describes better performance with the application of cyclic delay. *Id.* at 5. However, Kaiser also describes that “[a]s the results, showed in Fig. 11(a) and 11(b), signify, there is a saturation effect in terms of the cyclic diversity delay. It can be observed, that a cyclic delay of $\delta > 1.5 \mu s$ results in no further improvement.” *Id.* at 6.

2. Overview of Bauch (Exhibit 1007)

Bausch is a WIPO International Publication titled “Apparatus and Method for Cyclic Delay Diversity.” Ex. 1007, code (54).

First, Bauch notes that “[a] simple transmit diversity techniques is delay diversity where the same signal is transmitted from multiple antennas with different delay.” Ex. 1007, 3:12–14. Then, Bauch explains a problem with applying a simple delay:

However, introducing additional delay in multicarrier transmission systems, which is often required for achieving a time diversity, requires a longer guard interval which, consequently, results in a reduced bandwidth efficiency. If the guard interval is not sufficiently long, inter-carrier interference may occur. However, increasing the length of the guard interval results in a reduced bandwidth efficiency, since the guard interval cannot be applied to information transmission.

Id. at 3:22–30.

As a solution for the problem, Bauch proposes that “[a]n increased frequency selectivity without exceeding the guard interval can be achieved [by] introducing a cyclic delay diversity,” and refers to three papers that describe such cyclic delay diversity. Ex. 1007, 3:32–4:11. Specifically, Bauch states that “a delay is introduced in a cyclic manner such that the guard interval is not exceeded.” *Id.* at 4:12–14.

Bauch states: “In particular, it has been found that the spatial diversity can fully be exploited, when, at the transmitter or at the receiver, cyclic delay diversity scheme is used, wherein the cyclic delays are determined by a number of users. Ex. 1007, 7:33–8:4. Bauch also states: “In accordance with the present invention, the cyclic delay is chosen such that sub-carriers associated with sub-subsequent user signal values are uncorrelated.” *Id.* at 8:24–26. Bauch further states: “It is a further advantage of the present invention, that the inventive cyclic delay diversity concept is simple, since only shift operations are required in order to fully exploit the spatial diversity.” *Id.* at 8:31–9:2.

Bauch’s Figure 2 is described as showing “a correlation function for the inventive cyclic delay diversity scheme with two transmit antennas.” Ex. 1007, 9:18–20. Bauch’s Figure 4 is described as demonstrating “cyclic delay diversity in a coded OFDM (transmitter).” *Id.* at 9:27–28. Bauch’s

Figure 5 is described as demonstrating “cyclic delay diversity in a coded OFTM (receiver).” *Id.* at 9:30–31.

Bauch states: “In accordance with the present invention, the cyclic delay can be used in an already existing, standardized system having a fix interleaving and user assignment scheme in order to fully exploit spatial diversity.” Ex. 1007, 11:28–31. Bauch also states: “In accordance with the present invention, the cyclic delays are chosen such that a forward error correction decoder implemented in a receiver exploits, for each user, the full spatial diversity, which is inherent in a channel.” *Id.* at 15:3–6.

3. *Independent Claim 1*

We find below that Petitioner has not set forth sufficient reasoning as to why Kaiser, Bauch, and IEEE together teach or suggest limitation 1[b][ii]. We first discuss Petitioner’s contentions for the preamble of claim 1 and limitations 1[a][i] and 1[a][ii]. Then we discuss Petitioner’s assertions for limitation 1[b][i] of claim 1, Patent Owner’s counter-arguments with regard to limitation 1[b][i], and why Petitioner has made an adequate showing for limitation 1[b][i]. Thereafter, we explain why Petitioner’s accounting for limitation 1[b][ii] is misplaced and unpersuasive even for purposes of institution of review.

a. *Preamble Recitation — 1[preamble]*

The preamble recites: “A method for transmitting orthogonal frequency division multiplexing (OFDM) signals comprising.” Ex. 1001, 9:32–33. Petitioner asserts: “Kaiser teaches the preamble. *See* EX1003 ¶145. For example, Kaiser teaches that its ‘Fig. 4 shows . . . an *N*-transmitter-antenna OFDM system.’ *See* EX1006 at 2. That section of Kaiser and the portions discussed below teach the steps of a method for

using that transmitter to transmit OFDM signals. *See* EX1006 at 2–4; EX1003 ¶145.” Pet. 41. Patent Owner does not dispute Petitioner’s assertions.

b. Limitation 1[a][i]

Limitation 1[a][i] recites: “generating a first OFDM packet for transmission.” Ex. 1001, 9:34. Petitioner asserts “Kaiser teaches this limitation.” Pet. 41 (citing Ex. 1003 ¶¶ 147–47). As illustration, Petitioner reproduces an annotated version of Kaiser’s Figure 4 (Pet. 42):

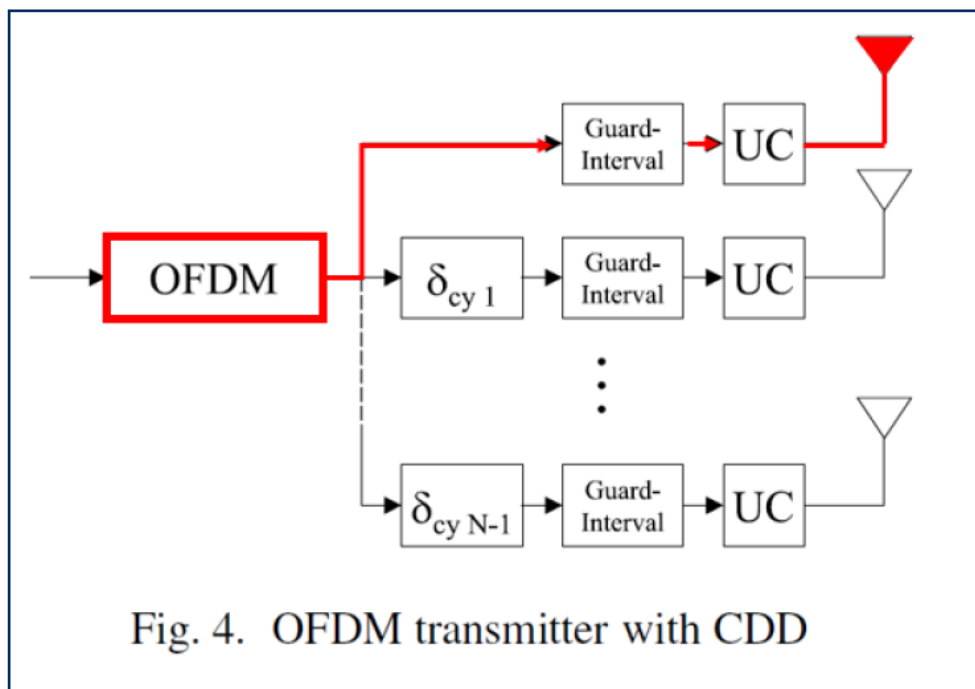


Fig. 4. OFDM transmitter with CDD

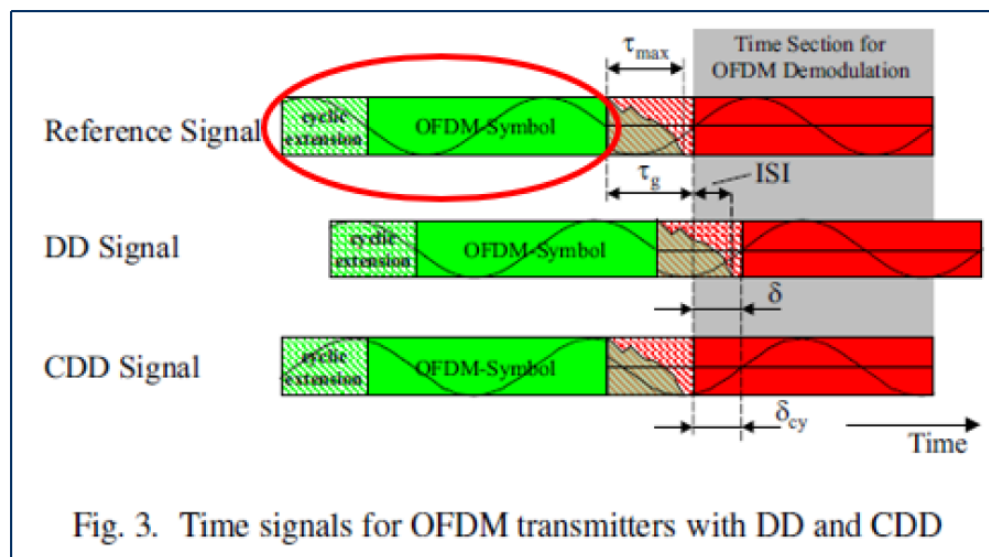
Kaiser’s Figure 4 is a block diagram of an N -transmitter-antenna OFDM system with cyclic delay diversity. Ex. 1006, 2. Petitioner has marked in red a first path from an incoming OFDM packet to a first antenna. Petitioner asserts that the process of generating this first OFDM packet is described in Kaiser’s Figure 9. Pet. 42 (citing Ex. 1003 ¶ 147). Petitioner also asserts that a POSITA (one of ordinary skill in the art) “would also have recognized that the first OFDM signal that is transmitted is a first OFDM packet

because OFDM is a packet-based transmission network as Kaiser recognizes.” *Id.* (citing Ex. 1003 ¶¶ 146–47; Ex. 1006, 5). Patent Owner does not dispute Petitioner’s assertions.

c. *Limitation 1[a][ii]*

Limitation 1[a][ii] recites: “including a guard interval portion and a symbol data portion each comprised of a plurality of samples.” Ex. 1001, 9:34–36. It modifies the OFDM packet recited in limitation 1[a][i]. *Id.*

Petitioner asserts “Kaiser teaches this limitation.” Pet. 42 (citing Ex. 1003 ¶¶ 148–50). As illustration, Petitioner reproduces an annotated version of Kaiser’s Figure 3 (Pet. 43):



Kaiser’s Figure 3 illustrates the difference between DD (delay diversity) and CDD (cyclic delay diversity) in the time domain and shows the transmission of two consecutive OFDM symbols with their cyclic prefixes as guard intervals. Ex. 1006, 2. Petitioner notes that Kaiser explains that the prepended “cyclic extension” serves as a “guard interval.” Pet. 43 (citing Ex. 1006, 2).

Petitioner explains:

A POSITA would have recognized that the OFDM packet's guard interval portion and symbol data portion were comprised of a plurality of samples. *See* EX1003 ¶150. Even the '439 Patent admits that, as part of the prior art IEEE 802.11 standard, there were "80 samples in an OFDM symbol waveform, [where] the guard interval [] consumes 16 samples ([and] the data portion comprising 64 samples)." *See* EX1001 at 2:26-30. Consistent with that admitted prior art and the standard, Kaiser teaches applying "a cyclic time shift of δ_{cy} " of, for example, 10 **samples**. *See* EX1006 at 2. Thus, the guard interval portion and symbol data portion of the first OFDM packet (and all other packets) are comprised of a plurality of samples, in accordance with the IEEE standard. *See* EX1003 ¶150.

Pet. 43. Patent Owner does not dispute these assertions of Petitioner.

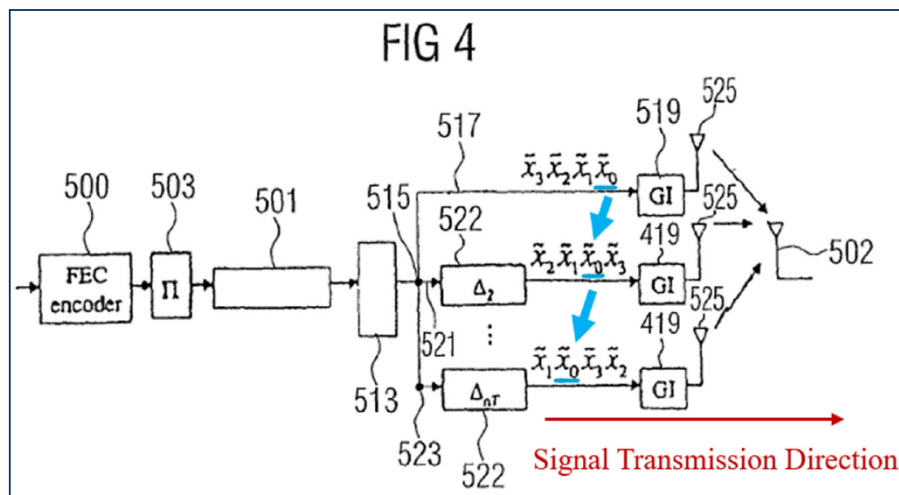
d. Limitation 1[b][i]

Limitation 1[b][i] recites: "cyclically advancing the first OFDM packet by shifting the samples in a first direction." Ex. 1001, 9:37–38.

Petitioner explains:

Kaiser teaches cyclically delaying (but not cyclically advancing) the first OFDM packets by shifting the samples in a direction [referring to Kaiser's cyclic time shift of δ_{cy}]. . . .

Bauch teaches cyclically advancing the packet by shifting the samples in the other direction. As background, Bauch's Figure 4 first teaches cyclically delaying the first OFDM packet (represented by unshifted signal 517) by shifting the samples in the direction opposite of signal transmission, just like Kaiser's Figure 3 and just like the '439 Patent admits was known:



[Petitioner annotates Bauch’s Figure 4 (showing cyclic delay diversity in an OFDM transmitter) to note the direction of transmission in red and the direction of delay in blue] See EX1007 at Fig. 4 (annotated), 22:23-23:2 (showing a “one coefficient” shift). Bauch refers to this shift as “a left-shift.” See *id.* at 22:30–32. Critically, however, Bauch then teaches: “Alternatively, the means 522 may be operative to perform a **right-shift.**” See *id.* at 22:30–23:1. As a POSITA would have recognized, a “left-shift” in Bauch is a cyclic delay, and shifting in the opposite direction, a “right-shift,” is a cyclic advance. See *id.* at 22:30–23:1; EX1003 ¶153.

As established above, Kaiser teaches cyclically delaying the first PFDM packet by shifting the samples in a direction, and Bauch then teaches cyclically advancing the OFDM packet by shifting the samples in a first direction that is the opposite direction of the delay shift taught by Kaiser. Thus, Kaiser in view of Bauch teaches cyclically advancing the first OFDM packet by shifting the samples in a first direction. *See* EX1003 ¶ 154.

Pet. 44–45 (footnote omitted).

Petitioner then explains two separate motivations for combining the teachings of Kaiser and Bauch as it proposes.

First, Petitioner explains:

Bauch expressly teaches that its disclosure should be applied to Kaiser's system:

An increased frequency selectivity . . . can be achieved introducing a cyclic delay diversity, as described in: . . . A. Dammann and S. Kaiser, "Low complex standard comfortable antenna diversity techniques for OFDM systems and its application to the DVB-T system", . . . [i.e. "Kaiser"]. . . . In accordance with the teachings of the above documents, a delay is introduced in a cyclic manner

EX1007 at 3:31-4:14. Thus, unsurprisingly, the relevant transmission systems of Kaiser and Bauch are very similar. *Compare, e.g.,* EX1006 at Fig. 4, *with* EX1007 at Fig. 4. A POSITA would have been motivated to apply Bauch's teaching of a "right-shift" (cyclic advance) to Kaiser's system because Bauch's system is expressly intended to be applied to Kaiser's system, and the similarities between the two evidence a reasonable expectation of success in combining them. *See* EX1003 ¶155.

Pet. 46. These assertions are sufficiently supported by the cited evidence, notwithstanding Patent Owner's counter-argument, which we discuss below.

Second, Petitioner explains:

A POSITA also would have been motivated to apply Bauch's teachings of a "right-shift" (cyclical advance) to Kaiser's system that teaches cyclical delay because a small cyclic advance is "identical or equivalent" to a large cyclic delay, and vice versa. *See* EX1001 at 8:5–18. Therefore, two identical ways exist to accomplish what Kaiser's system does, so it would have been obvious to try either of those two equivalent options. *See* EX1003 ¶156. This is why Bauch casually mentions the "right-shift" advance as an "alternative" to the "left-shift" delay—there is no difference when the shifts' magnitudes are correspondingly aligned. *See* EX1007 at 22:30-23:1. They are both equally acceptable, and both expressly contemplated by

Bauch as being applied to Kaiser's system. *See id.*; Ex. 1003, ¶¶151-56.

Pet. 46–47. These assertions are sufficiently supported by the cited evidence, notwithstanding Patent Owner's counter-argument, which we discuss below.

Patent Owner agrees, as Petitioner recognizes (Pet. 44), that Kaiser is limited to cyclic delay diversity. Prelim Resp. 30. Patent Owner asserts, however:

Like Larsson, Bauch makes clear that the “present invention” and every embodiment are limited to the implementation of cyclic delays:

The present invention is based on the finding that . . . In particular, it has been found that the spatial diversity can fully be exploited, when, at the transmitter or at the receiver, cyclic delay diversity scheme is used, wherein the cyclic delays are determined by a number of users. Ex. 1007, 7-8 (emphasis added).

* * *

In accordance with the present invention, the cyclic delay is chosen that sub-carriers associated with subsequent user signal values are uncorrelated. . . . *Id.*, at 8 (emphasis added).

It is a further advantage of the present invention, that the inventive cyclic delay diversity concept is simple, . . . Ex. 1007, 7-8 (emphasis added). *Id.*, at 8 (emphasis added).

* * *

Fig. 2 shows a correlation function for the inventive cyclic delay diversity scheme . . .

Fig. 4 demonstrates cyclic delay diversity in a . . .

Fig. 5 demonstrates cyclic delay diversity in a . . .

Fig. 6b shows the channel of Fig. 6a transformed by the cyclic delay diversity . . . *Id.*, at 9-10 (emphasis added).

* * *

In accordance with the present invention, the cyclic delay can be used in an already existing, standardized system . . . *Id.*, at 11 (emphasis added).

* * *

The inventive cyclic diversity scheme is based on an efficient exploitation of general correlation properties. To be more specific, *the inventive delays (shifts)* are chosen such that, . . . In particular for the case of an OFDM transmission scenario, an efficient choice of cyclic delay may . . . In accordance with the present invention, the cyclic delays are chosen such that . . . *Id.*, at 14-15 (emphasis added).

* * *

Fig. 2 shows a correlation function for an inventive cyclic delay diversity with two transmit antennas and a cyclic delay . . . The *cyclic delays (cyclic shifts[])* are chosen according to U where U is the number of users . . .

The inventive choice cyclic delay guarantees that . . . *Id.*, at 15 (emphasis added).

* * *

It is to be noted that the inventive cyclic shift operation introduces a cyclic delay having an influence on . . . *Id.*, at 19 (emphasis added).

* * *

. . . After influencing the phase of each value, the resulting frequency domain signals are then transformed back to time domain, so that delayed versions of the respective receive signals are obtained. *Id.*, at 20 (emphasis added).

* * *

... Each antenna introduces a different cyclic delay
... *Id.*, at 23 (emphasis added).

* * *

... the cyclic delay diversity transforms the multiple-multiple-output (MIMO) channel to a single-input-multiple-output (SIMO) channel having ...
In Fig. 6b, the transformation introduced by the cyclic delay diversity is demonstrated. *Id.*, at 24-25 (emphasis added).

Ex. 2001, ¶78.

Prelim. Resp. 33–35.

Patent Owner also asserts: “Bauch also makes clear in several places that, when it refers to a cyclic shift, it means a cyclic delay. *Id.*, at 14 (‘*the inventive delays (shifts)* are chosen such that, ...’); 15 (‘The cyclic delays (cyclic shifts[]) are chosen ...’); 19 (‘the inventive cyclic shift operation introduces a cyclic delay ...’). Ex. 2001, ¶79.” Prelim. Resp. 35.

These arguments do not undermine Petitioner’s showing for limitation 1[b][i]. No matter how numerous are the mentioning in Bauch of performing a cyclic delay and no matter how Bauch is titled, so long as Bauch discloses a single instance of performing a cyclic advance of the OFDM packet by shifting the samples in a first direction, Bauch discloses limitation 1[b][i]. Petitioner sufficiently has shown such an instance.

Petitioner’s expert, Dr. Bagherzafteh, explains, referring to Bauch’s disclosure of alternatively performing a right-shift instead of a left-shift (Ex. 1007, 22:30–23:1):

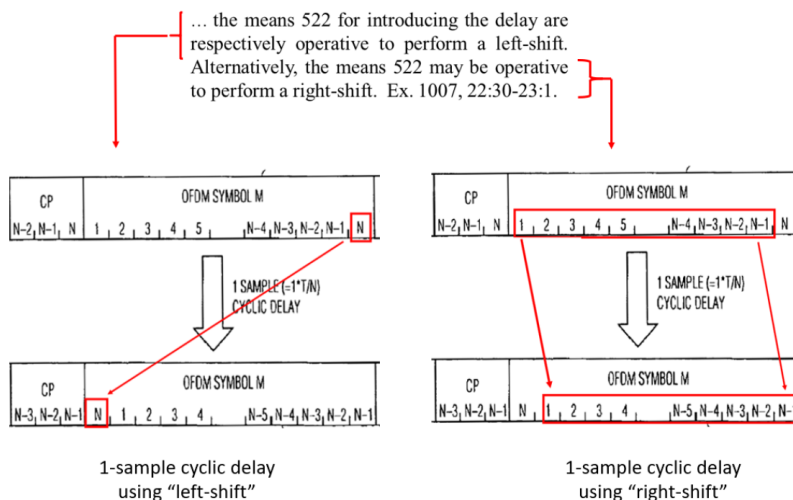
As a POSITA would recognize, cyclically shifting the samples in the opposite direction of a delay (which is a “left-shift” in Bauch) is a cyclic advance (which is a “right-shift” in Bauch). *Id.* at 22:30-23:1 (“As depicted in Fig. 4, the means 522 for introducing the delay are respectively operative to perform a left-

shift. Alternatively, the means 522 may be operative to perform a right-shift.”).

Ex. 1003 ¶ 153 (cited at Pet. 45). We credit this testimony of Dr. Bagherzafteh.

With regard to the Bauch disclosure focused on by Petitioner (Ex. 1007, 22:30–23:1), i.e., the description “. . . the means 522 for introducing the delay are respectfully operative to perform a left-shift. Alternatively, the means 522 may be operative to perform a right-shift,” Patent Owner asserts:

The stated function of means 522 is “for introducing the delay.” Similar to the passage in Larson discussed above, this passage in Bauch is stating that there are two ways for means 522 to introduce the cyclic delay: one way that means 522 can introduce the cyclic delay is to shift samples from the end of an OFDM symbol into the beginning of the OFDM symbol (the so-called “left-shift”), and the second way that means 522 can introduce the cyclic delay is by shifting samples from the beginning of the OFDM symbol into the end of the OFDM symbol (the so-called “right-shift”). Ex. 2001, ¶80. Reproduced below is the same illustration created by Patent Owner based on the Figures from Larsson shown previously, but modified to graphically illustrate implementation of a 1-sample cyclic delay using either the “left-shift” or “right-shift” described in Bauch:



Ex. 2001, ¶80. [According to Patent Owner, the left half of the illustration is implementing cyclic delay by making a “left-shift”; the right half of the illustration is implementing cyclic delay by making a “right-shift”; and both result in a 1-sample “cyclic delay.” Prelim. Resp. 35–36]

Prelim. Resp. 35–36.

These arguments are supported by the cited testimony of Dr. Lomp, but do not undermine Petitioner’s reasoning. According to the ’439 patent, a small cyclic advance is identical or equivalent to a large cyclic delay, and a small cyclic delay is identical or equivalent to a large cyclic advance, because the OFDM symbol repeats periodically. Ex. 1001, 8:5–21.

Specifically, the ’439 patent states:

Due to the periodic nature of OFDM subcarriers, mathematically, a small cyclic advance of 100 nsec is identical or equivalent to a large delay of 3100 nsecs (the OFDM symbol repeats with a period of 3.2 μ sec or 3200 nsec). In other words, 3100 nsec is a periodic equivalent to 100 nsec. Likewise, *a small delay of 100 nsec is identical to an advance of 3100 nsec, again due to the periodic nature of the OFDM symbol* 300 (e.g., FIG. 3). Thus, *a signal received by the SISO receiver device 112 (FIG. 6) having a cyclic advance of 100 nsec or a signal having a cyclic delay of 3100 nsec is processed as an identical signal from the perspective of the SISO receiver device 112*, since the EMA transmitter device 602 (FIG. 6) transmits the identical signal in each case. Since a circular shift is indeed circular, the FFT placement is at the same position shifting in either direction (100 nsec advance, 3100 nsec delay).

Id. (emphasis added). Thus, because of the periodic nature of OFDM carriers, a small cyclic delay is the same as a relatively large cyclic advance. Hence, Bauch provides two ways of implementing a cyclic delay, one representing a delay, and the other an advance that would be identical or equivalent to that delay.

Patent Owner's own side-by-side comparison of a left-shift and right-shift, shown above, confirms Bauch's disclosure of a cyclic advance. According to Patent Owner, the left half of the illustration shows the "left-shift"; the right half of the illustration shows the "right-shift"; and both result in a 1-sample "cyclic delay." Prelim. Resp. 35–36. Because of the opposite directions of sample shifting, one approach represents a delay and the other represents an advance, even though both result in the equivalent of a 1-sample cyclic delay. Patent Owner does not dispute that shifting samples in a direction opposite to that corresponding to a delay constitutes an advance. The 1-sample cyclic delay shown on the right side of the illustration is identical to a cyclic advance of an unspecified magnitude shown on the left side of the illustration.

Patent Owner asserts that "Bauch did not disclose (or even suggest) the *small* cyclic advance claimed in the '439 Patent." Prelim. Resp. 36 (citing Ex. 2001 ¶ 81) (emphasis added). This argument is misplaced and inconsequential in the context of limitation 1[b][i] which has no requirement for the length of the recited cyclic advance. For limitation 1[b][i], Petitioner has not asserted that the cyclic advance applied in one of the two disclosed approaches for achieving a 1-sample cyclic delay is a 1-sample cyclic advance. An advance of any sample size, even a large number of samples, is sufficient to meet limitation 1[b][i].

For the foregoing reasons, nothing presented by Patent Owner undermines the above-noted analysis of Petitioner and its expert for limitation 1[b][i]. Petitioner sufficiently has shown that Kaiser, Bauch, and IEEE together meet limitation 1[b][i].

e. *Limitation 1[b][ii]*

Limitation 1[b][ii] further modifies the cyclic advance recited in limitation 1[b][i] by requiring that the cyclic advance be “an amount less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission.” Ex. 1001, 9:38–41.

Petitioner asserts:

Kaiser in view of Bauch and IEEE renders this limitation obvious. *See* EX1003 ¶157. For example, Bauch teaches that in “accordance with the teachings of [Kaiser], a delay is introduced in a cyclic manner ***such that the guard interval is not exceeded.***” EX1007 at 4:11–14. Kaiser teaches that this shift is used to generate a shifted version of the first OFDM packet for transmission, as represented by the CDD Signal in Kaiser’s Figure 3 and also, for example, in the shifted signals in Kaiser’s Figure 4. *See* EX1006 at Figs. 3-4; EX1003 ¶157.

Pet. 47. Kaiser’s Figures 3 and 4 are reproduced below:

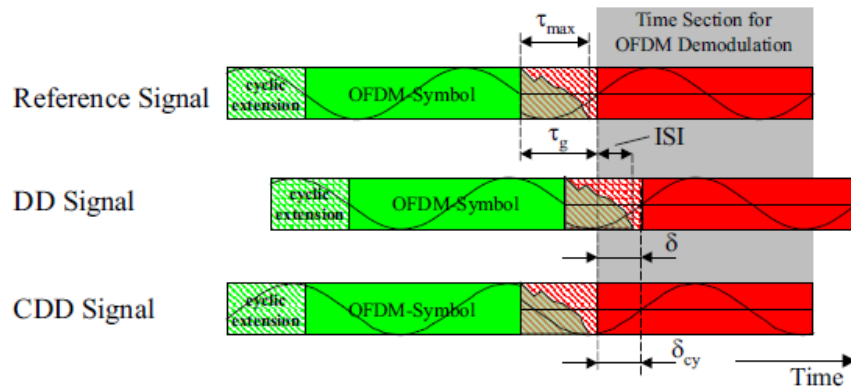


Fig. 3. Time signals for OFDM transmitters with DD and CDD

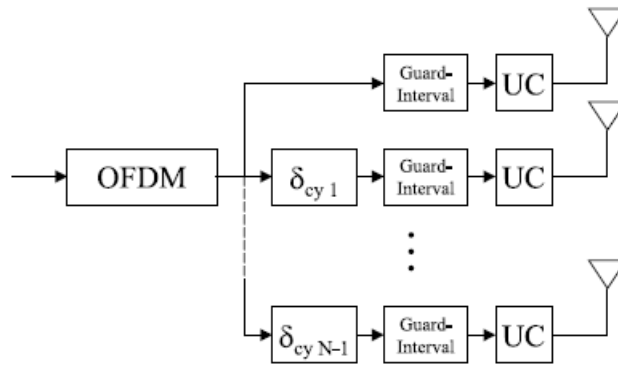


Fig. 4. OFDM transmitter with CDD

Figure 3 shows time signals for OFDM transmitters with DD and CDD.

Ex.1006, 2. Figure 4 shows an OFDM transmitter with CDD. *Id.*

Petitioner’s reasoning is misplaced and unpersuasive. Per limitation 1[b][ii], which modifies limitation 1[b][i], it is the *cyclic advance* in limitation 1[b][i] that must be “an amount less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission.” Ex. 1001, 9:37–41. At most, Petitioner has shown that the amount of *cyclic delay* implemented, i.e., δ_{cy} , is less than the cyclic extension or prefix which Petitioner treats as the guard interval. But that is not what is required by the claim. Petitioner has not shown the amount of the cyclic advance relied upon by Petitioner to satisfy the cyclic advance requirement of limitation 1[b][i] meets the duration requirement of limitation 1[b][ii].

Petitioner has not shown or even attempted to show that a cyclic advance is the same as a cyclic delay of the same amount. Further, that is not true according to the disclosure of the ’439 patent, which states:

Due to the periodic nature of OFDM subcarriers, mathematically, a small cyclic advance of 100 nsec is identical or equivalent to a large delay of 3100 nsecs (the OFDM symbol repeats with a period of 3.2 μ sec or 3200 nsec). In other words, 3100 nsec is a periodic equivalent to 100 nsec. Likewise, a small delay of 100 nsec is identical to an advance of 3100 nsec, again due to the periodic nature of the OFDM symbol 300 (e.g., FIG. 3). Thus, a signal received by the SISO receiver device 112 (FIG. 6) having a cyclic advance of 100 nsec or a signal having a cyclic delay of 3100 nsec is processed as an identical signal from the perspective of the SISO receiver device 112, since the EMA transmitter device 602 (FIG. 6) transmits the identical signal in each case. Since a circular shift is indeed circular, the FFT placement is at the same position shifting in either direction (100 nsec advance, 3100 nsec delay).

Ex. 1001, 8:5–21. Petitioner has not explained what is the amount of the cyclic advance that is used to achieve the cyclic delay δ_{cy} that is less than the guard interval. A cyclic advance that equates to Bauch's small cyclic delay would be large, based on the record and as acknowledged by Petitioner. *Id.*; Pet. 46. Petitioner has not shown that the amount of cyclic advance disclosed by Bauch is "less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission" as required by limitation 1[b][ii].

For the foregoing reasons, Petitioner has not sufficiently shown that Kaiser, Bauch, and IEEE together discloses or suggest limitation 1[b][ii].

f. Conclusion for Claim 1

Petitioner has not shown a reasonable likelihood that it would prevail in establishing obviousness of claim 1 over Kaiser, Bauch, and IEEE.

4. Dependent Claims 2–7

Claims 2–7 each depend, directly or indirectly, from claim 1.

Ex. 1001, 9:51–10:6. The deficiency of the Petition, as discussed above for

claim 1, applies equally to claims 2–7. Petitioner has not shown a reasonable likelihood that it would prevail in establishing obviousness of any of claims 2–7 over Kaiser, Bausch, and IEEE.

5. *Independent Claim 8*

Limitation 8[b] recites, in part, “a second transmit processor for *cyclically advancing the first OFDM packet by shifting the samples in a first direction an amount less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission . . .*” Ex. 1001, 10:14–18 (emphasis added). The italicized function of the second transmit processor is identical to the steps recited in limitations 1[b][i], 1[b][ii], and 1[b][iii]. For this feature, Petitioner relies on the same analysis it provides for limitations 1[b][i] and 1[b][ii]. Pet. 54.

For the same reasons Petitioner has not made a sufficient showing that Kaiser, Bausch, and IEEE together teach or suggest limitation 1[b][ii], Petitioner has not made a sufficient showing that Kaiser, Bausch, and IEEE teach or suggest this portion of limitation 8[b]: “a second processor for cyclically advancing the first OFDM packet by shifting the samples in a first direction an amount less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission.”

Petitioner has not shown a reasonable likelihood that it would prevail in establishing obviousness of claim 8 over Kaiser, Bausch, and IEEE.

6. *Dependent Claims 9–18*

Claims 9–18 each depend, directly or indirectly, from claim 8. Ex. 1001, 10:37–11:4. The deficiency of the Petition, as discussed above for claim 8, applies equally to claims 9–18. Petitioner has not shown a

reasonable likelihood that it would prevail in establishing obviousness of any of claims 9–18 over Kaiser, Bausch, and IEEE.

7. *Independent Claim 19*

Limitation 19[b] recites, in part: “means for *cyclically advancing the first OFDM packet including a guard interval portion and a symbol data portion each compromised of a plurality of samples by shifting the samples in a first direction an amount less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission.*” Ex. 1001, 11:11–17 (emphasis added). The italicized function of the recited means is the same as the steps recited in limitations 1[a][ii], 1[b][i], and 1[b][ii]. For this feature, Petitioner relies on the same analysis it provides for limitation 8[b]. Pet. 68.

For the same reasons Petitioner has not made a sufficient showing that Kaiser, Bausch, and IEEE together satisfy limitation 8[b], Petitioner has not made a sufficient showing that Kaiser, Bausch, and IEEE together teach or suggest this recited function of limitation 19[b]: “cyclically advancing the first OFDM packet including a guard interval portion and a symbol data portion each compromised of a plurality of samples by shifting the samples in a first direction an amount less than a sample duration of the guard interval portion to generate a shifted version of the first OFDM packet for transmission.”

Thus, Petitioner has not shown a reasonable likelihood that it would prevail in establishing obviousness of claim 19 over Kaiser, Bausch, and IEEE.

8. *Dependent Claims 20 and 21*

Claims 20 and 21 each depend directly from claim 19. Ex. 1001, 12:10–19. The deficiency of the Petition, as discussed above for claim 19, applies equally to claims 20 and 21. Petitioner has not shown a reasonable likelihood that it would prevail in establishing obviousness of either claim 20 or 21 over Kaiser, Bausch, and IEEE.

F. *Discretionary Denial Under 35 U.S.C. § 325(d)*

Patent Owner contends “THE PRIOR ART RELIED ON IN THE PETITION IS CUMULATIVE OF THAT ADVANCED BY THE EXAMINER AND OVERCOME DURING PROSECUTION.” Prelim. Resp. 37. We have discretion to deny institution under 35 U.S.C. § 325(d) based on the framework set forth in *Advanced Bionics, LLC v. Med-El Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 (PTAB Feb. 13, 2020) (precedential). However, we need not reach the issue of discretionary denial under 35 U.S.C. § 325(d), because we have determined, as explained above, that Petitioner has not shown a reasonable likelihood that it would prevail in establishing unpatentability of any challenged claim under any asserted ground.

G. *Discretionary Denial Under 35 U.S.C. § 314(a)*

Citing *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB March 20, 2020) (precedential), Patent Owner states that “Parallel Litigation [before the district court] has already reached an advanced stage” and that “there are strong reasons for exercising discretion to deny institution here.” Prelim. Resp. 49–50. We need not reach the issue of discretionary denial under 35 U.S.C. § 314(a) and *Fintiv*, because we determine Petitioner has

not shown a reasonable likelihood that it would prevail in establishing that any challenged claim of the '439 patent is unpatentable.

IV. CONCLUSION

For the foregoing reasons, we determine that Petitioner has not shown a reasonable likelihood that Petitioner would prevail in establishing that at least one of claims 1–21 of the '439 patent is unpatentable.

V. ORDER

It is ORDERED that no *inter partes* review is instituted in this proceeding.

IPR2024-01244
Patent 7,623,439 B2

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