

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

INTELLECTUAL VENTURES I LLC,
Patent Owner.

Case IPR2024-01244

U.S. PATENT NO. 7,623,439

PETITION FOR *INTER PARTES* REVIEW

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1001	U.S. Patent No. 7,623,439 (the “’439 Patent”)
1002	Certified File History of the ’439 Patent
1003	Declaration of Dr. Nader Bagherzadeh
1004	<i>Consultant Curriculum Vitae</i> of Dr. Nader Bagherzadeh
1005	U.S. Patent No. 6,842,487 B1 (“Larsson”)
1006	Stefan Kaiser and Armin Dammann, “ <i>Low Complex Standard Conformable Antenna Diversity Techniques for OFDM Systems and its Application to the DVB-T System</i> ,” 2002 International ITG Conference on Source and Channel Coding, January 2002 (“Kaiser”)
1007	WIPO International Publication No. WO 2005/041441 A1 (“Bauch”)
1008	Institute of Electrical and Electronics Engineers’, “Supplement to IEEE 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 1999 (“IEEE”)
1009	<i>Intellectual Ventures I LLC et al. v. Lenovo Group Limited</i> , Case No. 6:23-cv-00307-ADA, Dkt. 60, Claim Construction Order (May 28, 2024) (“Lenovo Order”)
1010	<i>Intellectual Ventures I LLC v. TCL Electronics Holdings Ltd., et al.</i> , Case No. 6:23-cv-00309-ADA, Dkt. 35, Corrected Joint Claim Construction Statement (June 18, 2024) (“Joint Claim Construction Statement”)
1011	WIPO International Publication No. WO 2005/081481 A1 (“Auer”)
1012	U.S. Patent Pub. No. US 2005/0265275 A1 (“Howard”)
1013	U.S. Patent Pub. No. US 2002/0122499 A1 (“Kannan”)
1014	Y.J. Liu, <i>Introduction to OFDM Receiver Design and Simulation</i> (2020) (“Liu”)
1015	Affidavit of Nathaniel E Frank-White (“Frank-White Affidavit”)

I. INTRODUCTION

U.S. Patent No. 7,623,439 (“the ’439 Patent”) is directed to one minor modification to prior art wireless communication systems. Everything about the claimed systems and methods—the hardware, the data structures, the flow of operations—was well known and routine in the art, so much so that all were admitted to be prior art in the ’439 Patent itself. The purported difference between the prior art and the ’439 Patent is that, where the prior art shifted data in a packet in one direction, the ’439 Patent shifted the data in the other direction. *Compare* EX1001 at Fig. 5 (admitted prior art), *with* Fig. 8 (purported invention).

This minor modification was not inventive. As the ’439 Patent admitted, the two shifts are “*identical or equivalent*.” *See id.* 8:3-9. Moreover, shifting data in either direction was not innovative, because at least two of the prior art references discussed in this Petition taught shifting data in each direction (and did so casually, because, again, both shifts are identical).

In view of the prior art teachings, Petitioners respectfully request that IPR of the ’439 Patent be instituted and that the Challenged Claims be cancelled.

II. OVERVIEW OF CHALLENGE

A. 37 C.F.R. § 42.104(b)(1)

Petitioners challenge Claims 1-21 of the ’439 Patent (the “Challenged Claims”).

B. 37 C.F.R. § 42.104(b)(2)

The '439 Patent was filed on May 4, 2005, but claims priority to U.S. Provisional Application 60/572,481 filed on May 20, 2004. Petitioners therefore use May 20, 2004, as the priority date. The '439 Patent is subject to pre-AIA law.

The claims are challenged based on at least the following prior art:

- **Larsson** (EX1005): a U.S. patent filed on September 22, 2000. Larsson therefore qualifies as prior art under at least 35 U.S.C. § 102(e)².
- **Kaiser** (EX1006): a conference paper from the 2002 International ITG Conference on Source and Channel Coding, held January 2002. *See* EX1007 at 4:4-8. It was publicly available by February 2002, and in no event later than March 31, 2003. *See id.*; EX1015 at 1-11. Kaiser therefore qualifies as prior art under at least § 102(a)-(b).
- **Bauch** (EX1007): a WIPO International Application filed on September 30, 2003 that designated the U.S. and was published in English. Bauch therefore qualifies as prior art under at least § 102(e).
- **IEEE** (EX1008): a supplement to IEEE Standard 802.11-1999 that was published on December 30, 1999. *See* EX1008. IEEE therefore qualifies as prior art under at least § 102(a)-(b).

² All citations to 35 U.S.C. are to the pre-AIA law.

Petitioners request cancellation on the following grounds:

Ground ³	Basis	Claims	Proposed Rejection
I	§ 103	1-21	Obvious over Larsson in view of IEEE
II	§ 103	1-21	Obvious over Kaiser in view of Bauch and IEEE

C. 37 C.F.R. § 42.104(b)(4)

An explanation of how the Challenged Claims are unpatentable is provided below.

D. 37 C.F.R. § 42.104(b)(5)

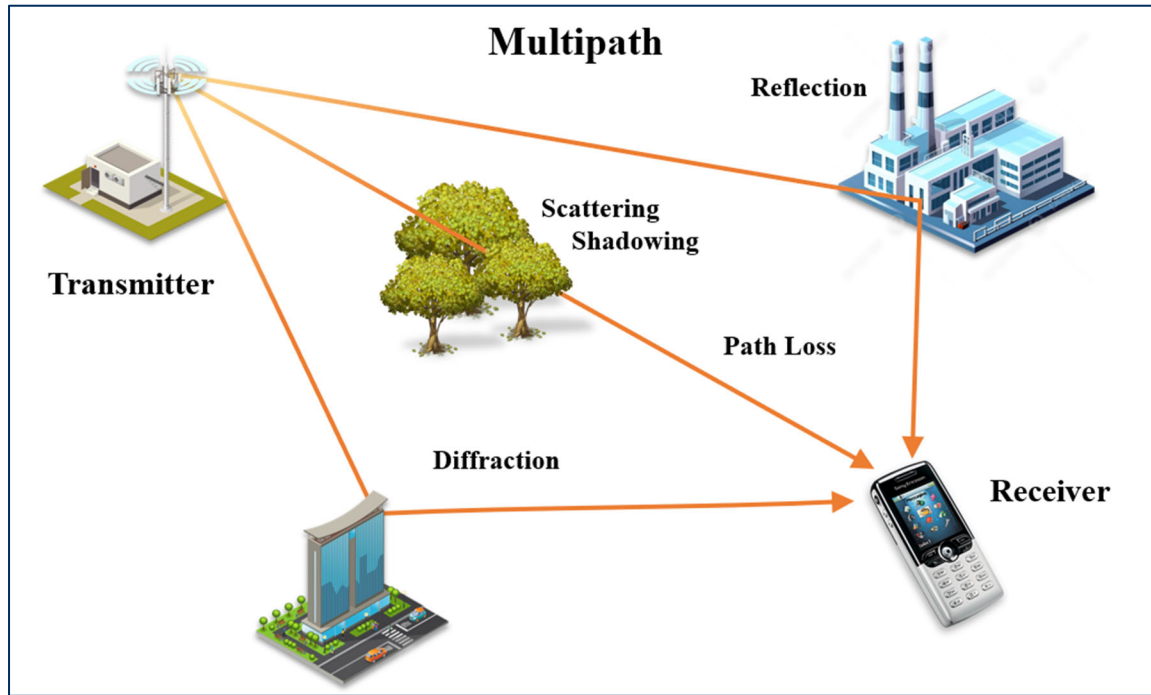
An exhibit list is provided at the beginning of this Petition. The relevance is discussed below.

III. OVERVIEW OF THE '439 PATENT

The '439 Patent is directed to a minor modification to well-known, standardized wireless communication systems using orthogonal frequency division multiplexing ("OFDM") technology. *See* EX1001 at 1:18-23. As the '439 Patent admits was known to a person of ordinary skill in the art (POSITA), wirelessly

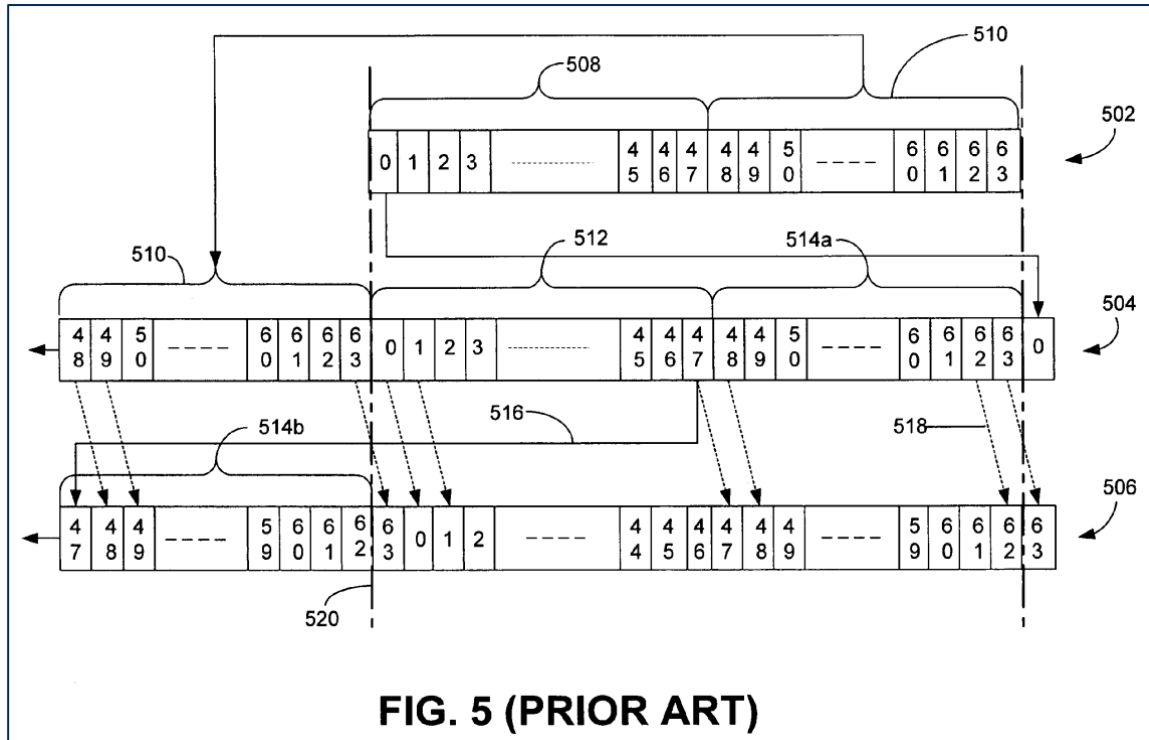
³ Both Grounds are supported by a POSITA's knowledge as evidenced by, among other things, the applicant-admitted prior art.

transmitted data signals taking different paths to the receiver (“multipath”) as shown below leads to signal interference:



EX1003 ¶¶40-41; *see* EX1001 at 2:16-21, Fig. 1.

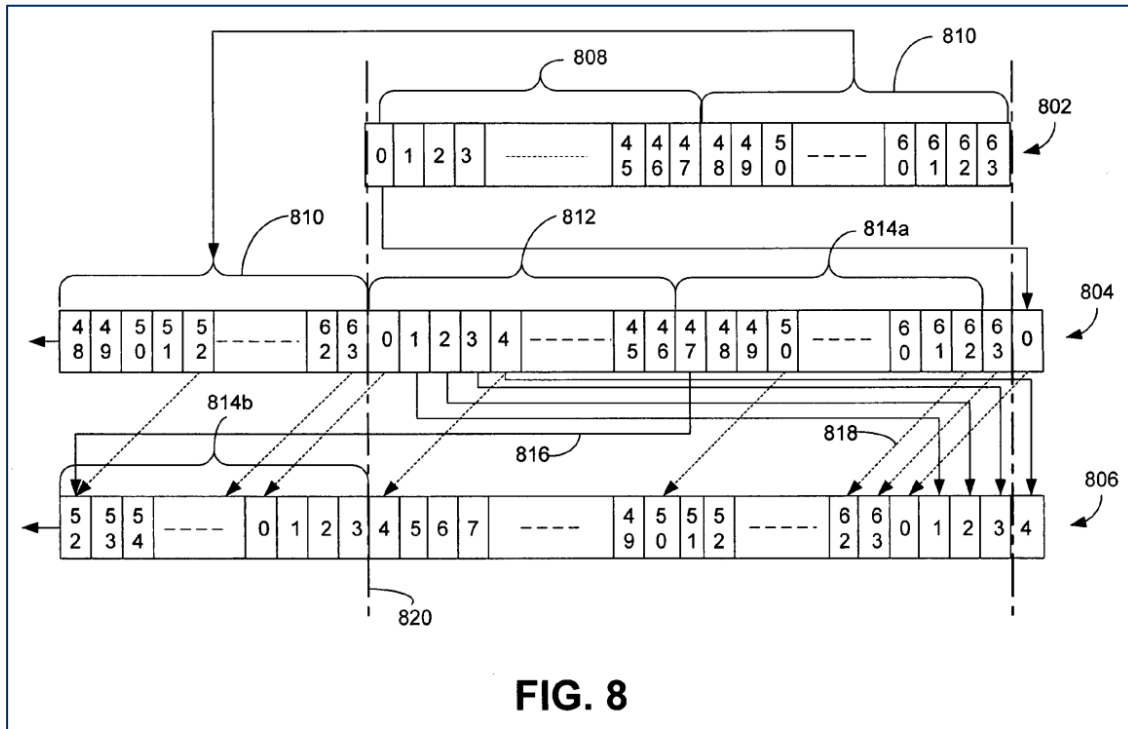
One well-known technique to reduce interference caused by multipath was to insert a time delay to act as a sort of buffer. *See* EX1001 at 2:18-21. Cyclic delay was another well-known technique that the '439 Patent illustrates in Figure 5 and admits is prior art:



The top row 502 of Figure 5 of the '439 Patent shows 64 data samples (numbered 0 through 63) that comprise a useful data portion of a larger packet. *See id.* at 3:58-61. The middle row 504, shows 16 data samples comprising the guard interval (which serves as a sort of buffer) being prepended to the front of the packet (element 510). *See id.* at 3:61-65. In the bottom row 506, a cyclic delay is shown, wherein the symbols are shifted one sample backwards. *See id.* at 3:65-4:4.

The purported invention replicates Figure 5's cyclic delay but shifts samples in the opposite direction. By contrast with prior art Figure 5 where the samples are shifted to the right (opposite the direction of transmission, as indicated by the

horizontal arrows on the far left), the purported invention depicted in Figure 8 shifts samples to the left (in the direction of transmission)⁴:



See id. at Fig. 8. Nothing about the hardware used to shift, nor the pre-processing that creates the samples to shift, nor the post-processing that transmits the shifted packet is even purportedly new. The '439 Patent just shifts the samples in the forward direction (a so-called “cyclic advance”) as opposed to how the admitted prior art allegedly shifted the samples (a “cyclic delay”).

⁴ Figure 5 depicts a one-sample shift whereas Figure 8 depicts a four-sample shift, but the shift’s magnitude is irrelevant here.

Notably, the '439 Patent admits that “[d]ue to the periodic nature of OFDM subcarriers, mathematically, a small cyclic advance of [for example] 100 nsec is ***identical or equivalent*** to a large delay of 3100 nsecs.” *See id.* at 8:5–9. By way of analogy, if you were standing on the National Mall in Washington, D.C. and looking at the Capital, whether you turn 90 degrees clockwise or 270 degrees counterclockwise, you would be looking at the same thing. A POSITA would have recognized that and would not have considered that innovative. *See id.*

IV. PERSON OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art (“POSITA”) at the time of the '439 Patent 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. *See* EX1003 ¶31.

V. CLAIM CONSTRUCTION

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 difference 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.

In the Texas Litigation, Petitioners have contended that the first step in Claim 1⁵ (“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.

Claim 19 is a means-plus-function claim, and for purposes of this Petition only, Petitioners propose the following constructions⁶:

Limitation	Structure	Function
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	Cyclically advancing the first OFDM packet including a guard interval portion and a symbol

⁵ This dispute applies to Claim 8 (a system claim) and Claim 19 is (a means-plus-function claim) as well because those claims recite processors and means configured to perform functions that correspond to the steps recited in Claim 1.

⁶ Petitioners do not admit that ’439 Patent discloses sufficient structure to satisfy 35 USC § 112.

	algorithm disclosed in elements 804-806 of Figure 8 of the '439 Patent	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
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

Petitioners are not presently aware of any other terms that need to be construed at this time.

VI. SUMMARY OF THE PRIOR ART

A. Larsson

Larsson is a U.S. patent titled “Cyclic Delay Diversity for Mitigating Intersymbol Interference in OFDM Systems.” See EX1005 at Cover Page. A certain portion, but *not* the key portion, of Larsson was substantively discussed during prosecution. Specifically, the Examiner only discussed or cited Larsson’s

teachings at 6:40-7:37 and Figures 8-9 for the “cyclic advancement” limitation in the ’439 Patent, but that portion of Larsson is not relied upon in this Petition to teach cyclic advancement. *See* EX1002 at 964-969, 994-1000, 1047-1055. Instead, this Petition relies on another portion of Larsson that was never addressed and is not tethered to the portions of Larsson that were considered by the Examiner. Specifically, the portion of Larsson relied upon in this Petition is:

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.

The Examiner’s oversight of this portion of Larsson is understandable because of its odd phrasing and placement. This teaching in Larsson is phrased in a manner that seemingly describes shifting “samples from the beginning of the OFDM symbol ... into the end of the OFDM symbol” as just another way of “implementing cyclic delay,” even though that would actually be cyclic advancement in the nomenclature of the ’439 Patent. Larsson did not use that “cyclic advance” terminology, however, which appears to have reasonably caused the Examiner to overlook this key teaching.

Larsson is analogous prior art, including because (a) it is in the same field as the '439 Patent⁷, and (b) is directed to the same problem as the '439 Patent in using cyclic diversity techniques to reduce error rates in OFDM communication systems. *See* EX1001 at, *e.g.*, 1:6–10; EX1003 ¶¶66-67.

B. Bauch

Bauch is a WIPO International Publication titled “Apparatus and Method for Cyclic Delay Diversity.” *See* EX1007 at Cover. Bauch discusses an OFDM wireless communication system that is capable of “cyclical[ly] shifting a multi-user signal” where the “cyclical shift allows a full exploitation of spatial diversity.” *See id.* at Abstract. Like Larsson, Bauch expressly teaches cyclical shifts in *either* direction, at the POSITA’s election—again directly targeting the '439 Patent’s only purported distinction relative to the admitted prior art. *See id.* at 22:30-23:1⁸.

Bauch is analogous prior art, including because (a) it is in the same field as the '439 Patent, and (b) is directed to the same problem as the '439 Patent in using

⁷ *See* EX1001 at 1:14-16 (“The present disclosure is generally related to communication systems, and, more particularly, is related to wireless communication systems and methods[.]”).

⁸ All page citations to EX1007 (Bauch) are to the sequentially stamped page at the bottom of the exhibit.

diversity techniques to reduce error rates in OFDM communication systems. *See* EX1003 ¶¶68-69.

C. Kaiser

Kaiser is a paper titled “Low Complex Standard Conformable Antenna Diversity Techniques for OFDM Systems and its Application to the DVB-T System.” *See* EX1006 at 1. Kaiser investigates “different antenna diversity concepts, which can be easily applied to orthogonal frequency division multiplexing (OFDM) systems.” *See id.*, Abstract. These “diversity concepts” include, in particular, cyclic delay diversity that tracks directly with Figure 5 of the ’439 Patent. *See id.* § 1. As discussed further below, Kaiser teaches all of the structures and processes underlying cyclical diversity used by the ’439 Patent.

Kaiser is analogous prior art, including because (a) it is in the same field as the ’439 Patent, and (b) is directed to the same problem as the ’439 Patent in using diversity techniques to reduce error rates in OFDM communication systems. *See* EX1003 ¶¶70-71.

D. IEEE

IEEE is a part of the IEEE Standard 802.11a-1999. *See* EX1008 at Cover. IEEE adds Clause 17 to the base standard, *id.* at 15, which “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.” *See id.* at 15. IEEE teaches the underlying standards by which OFDM systems were generally expected to have complied with, including when applying cyclical shifting techniques in order to reduce interference during transmission. *See id.*; EX1003 ¶72.

IEEE is analogous prior art, including because (a) it is in the same field as the ’439 Patent, and (b) is directed in part to the same problem as the ’439 Patent in using diversity techniques to reduce error rate in OFDM communication systems. *See* EX1008 at, *e.g.*, 20; EX1003 ¶73.

VII. INVALIDITY GROUNDS

A. Ground I: Claims 1-21 Are Obvious Over Larsson In View Of IEEE

1. Claim 1

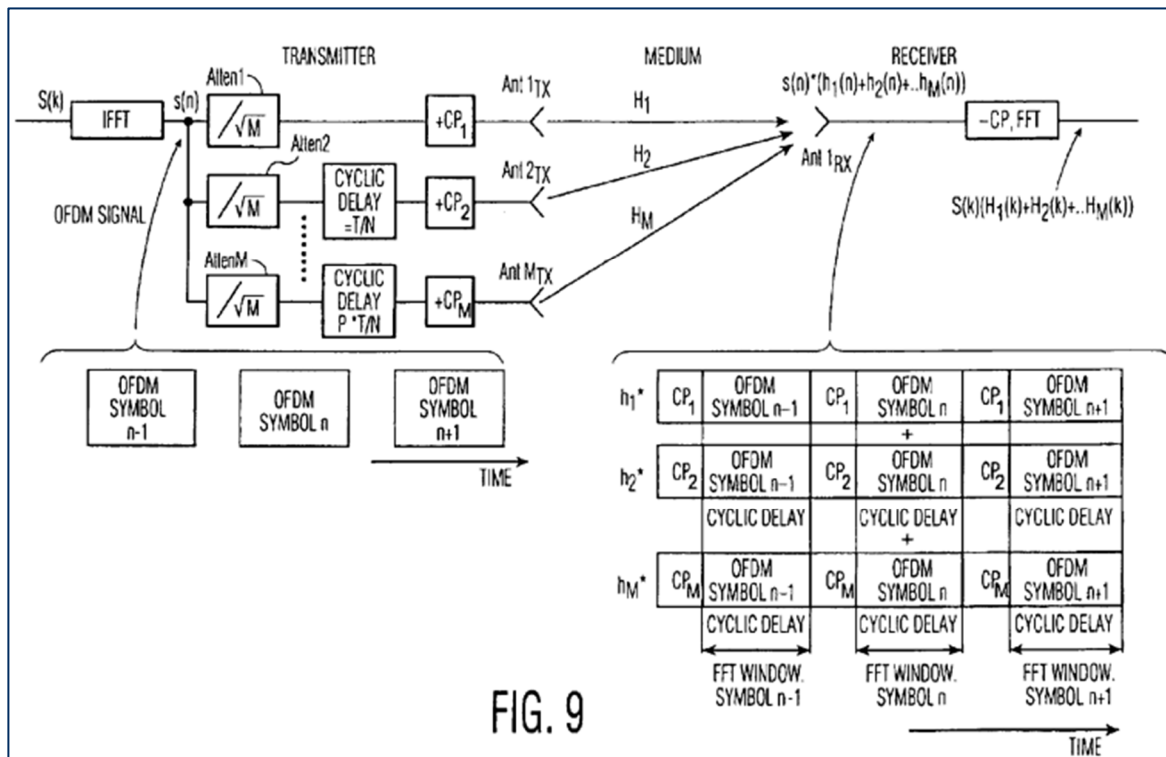
Larsson in view of IEEE renders obvious Claim 1.

a. Limitation 1[preamble]

Larsson teaches the preamble. *See* EX1003 ¶75. Larsson’s Figure 9, for example, shows multiple OFDM signals being transmitted. *See* EX1005 at Fig. 9. Larsson further teaches the method by which those OFDM signals are generated and transmitted. *See, e.g., id.* at 6:58-60 (“FIG. 9 illustrates ... a OFDM transmission scheme”).

b. Limitation 1[a][i]

Larsson teaches this limitation. See EX1003 ¶¶76-77. Larsson's Figure 9, for example, 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:

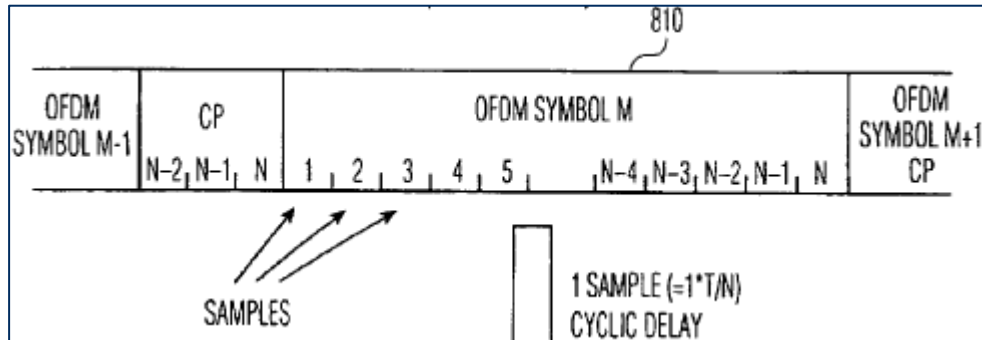


See EX1005 at Fig. 9.

c. Limitation 1[a][ii]

Larsson teaches this limitation. See EX1003 ¶¶78-79. As shown, for example, in this cropped portion of Larsson's Figure 8, the first OFDM packet includes a guard interval portion ("CP" in the figure, meaning cyclic prefix, which Larsson teaches is a guard interval) and a symbol data portion (corresponding to

samples 1 through N in the OFDM SYMBOL M portion), that are each comprised of a plurality of samples:



See EX1005 at Fig. 8 (cropped), 1:31-32 (“a guard interval, or cyclic prefix (CP)”); see also *id.* at, e.g., Abstract (“[T]he guard interval which precedes the symbol.”). As Larsson teaches and a POSITA 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.

d. Limitation 1[b][i]

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

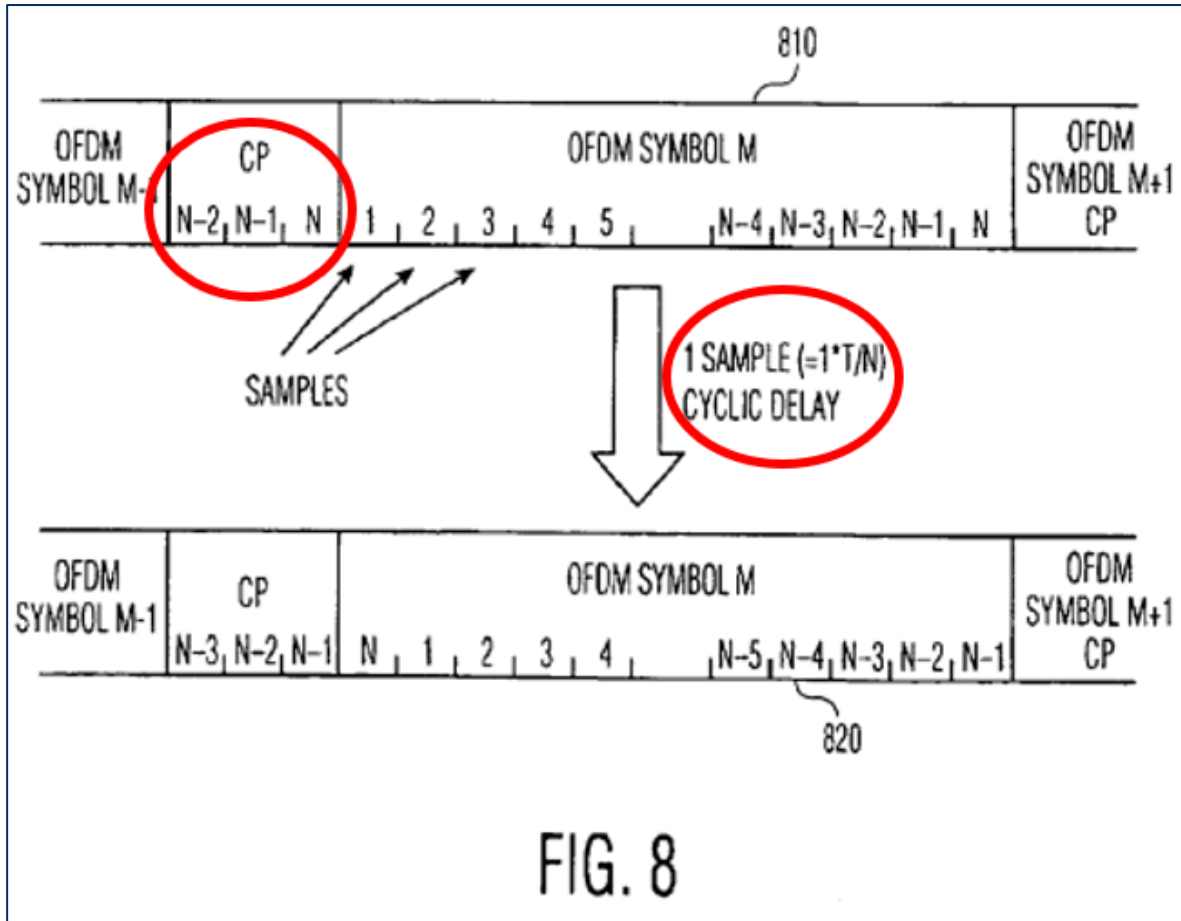
symbol, *the present invention can also be implemented so that the samples from the beginning of the OFDM symbol are shifted into the end of the OFDM symbol.*

See EX1005 at 9:41–47. Larsson refers to a shift in the first direction described above as a cyclic delay⁹, so a POSITA would recognize that a shift in the opposite direction is a cyclical 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.

e. Limitation 1[b][iii]

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:

⁹ See EX1005 at 6:46-48 (“[T]he cyclic delay is implemented by shifting samples from the end of the OFDM symbol into the beginning....”).

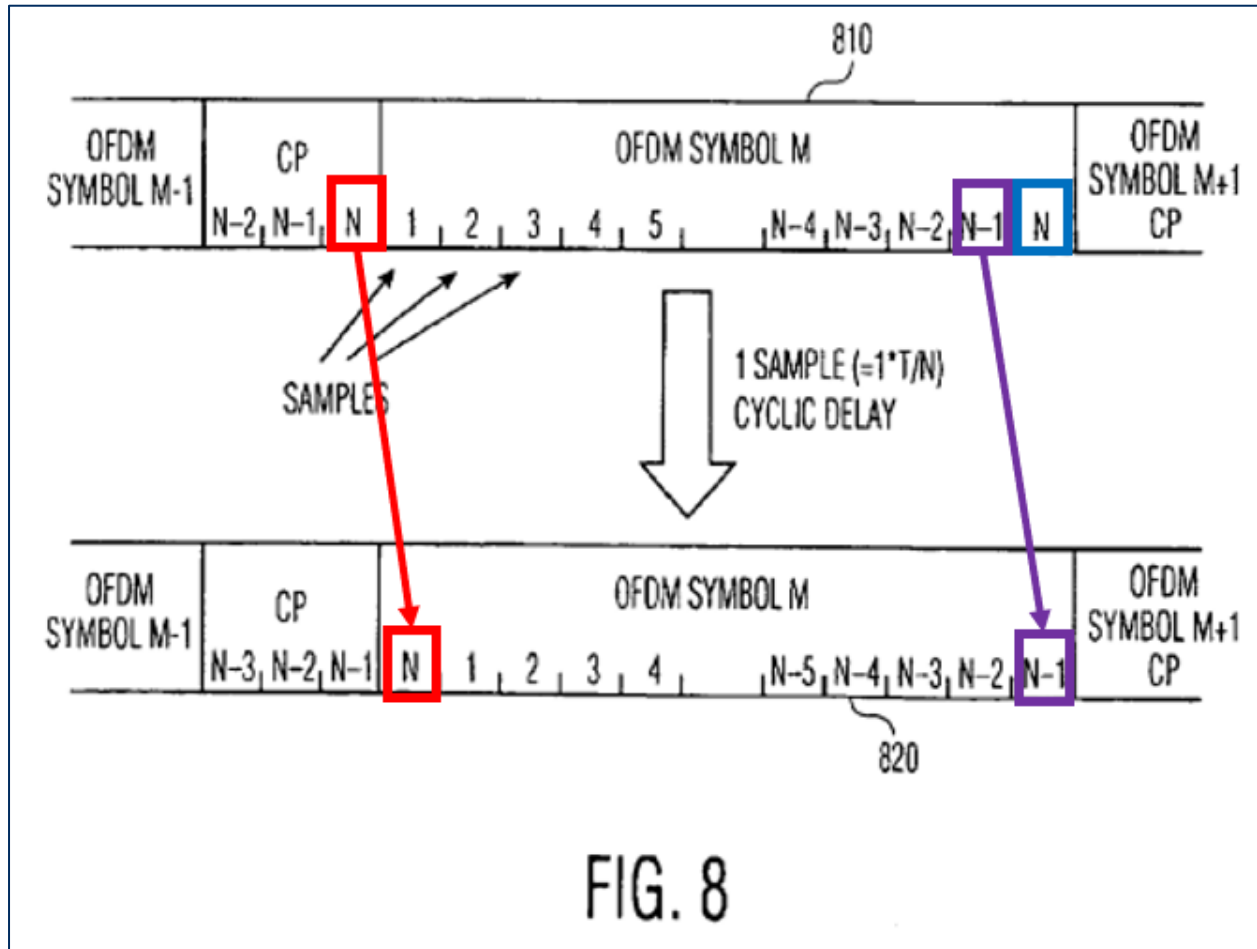


See EX1005 at Fig. 8 (annotated). The 1-sample cyclic shift is less than the 3-sample duration illustrated. This shift generates the shifted version of the first OFDM packet (bottom half of Figure 8), and the shifted version (as well as the unshifted version) is for transmission because Figure 8 represents “two OFDM symbols ... being transmitted.” See *id.* at 6:39–41; EX1003 ¶82.

f. Limitation 1[b][iii]

Larsson teaches this limitation. See EX1003 ¶¶83-84. As shown in Figure 8 which illustrates cyclic delay, a non-zero number of **samples from the guard**

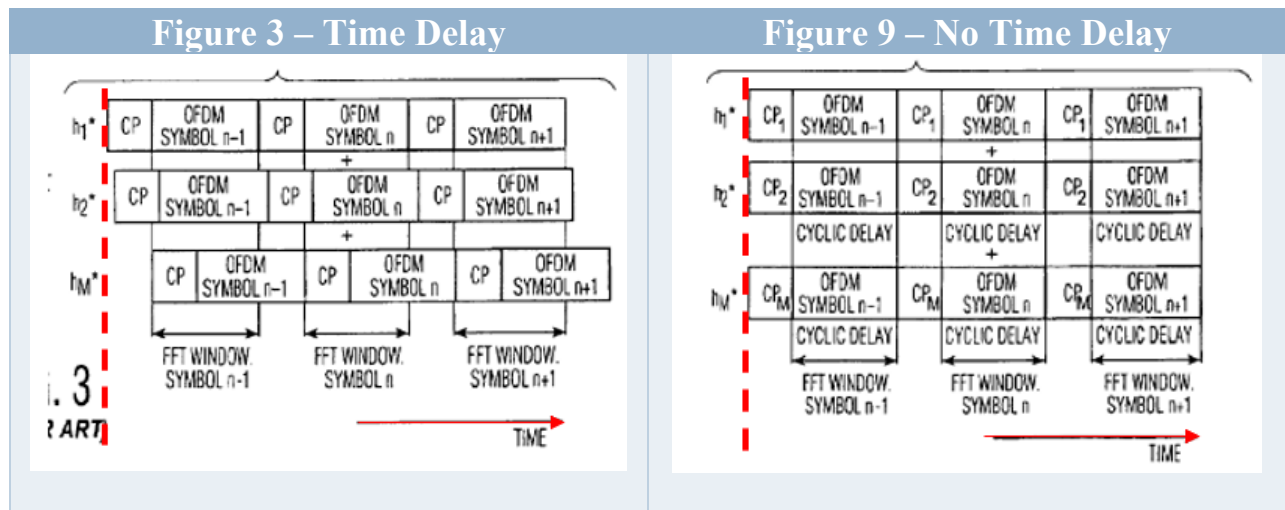
interval are shifted into the symbol data portion, which shifts the same number of samples towards the end, which shifts the same number of samples out:



See EX1005 at Fig. 8 (annotated). In cyclic advance as also taught but not illustrated in Larsson, where the shift is in the opposite direction, the opposite would occur, as a POSITA would recognize: A non-zero number of samples from the symbol data portion of the first OFDM packet would be shifted into the guard interval, and the same number of samples in the guard interval portion would be shifted out of the guard interval. See EX1003 ¶¶83-84.

g. Limitation 1[c]

Larsson teaches, or at least renders obvious, this limitation. *See* EX1003 ¶¶85-86. Larsson teaches that, after generating the shifted version of the OFDM packet, the “transmitter then transmits the symbols,” and does not teach any delay nor a different time for transmitting the symbols, such that a POSITA would understand this teaches, or at least renders obvious, substantially simultaneous transmission. *See* EX1005 at 8:5-6; EX1003 ¶¶85-86. This suggestion is confirmed by comparing, for example, Larsson’s Figure 3 (not relied upon for the claim limitations above), which shows a lag between received packets when a time delay is applied, relative to Larsson’s Figure 9 (which is relied upon in this Petition), which shows no time lag at the receiver between the original and shifted OFDM packets:



See EX1005 at Figs. 3, 9 (annotated, cropped); EX1003 ¶¶85-86.

2. Claim 2

Larsson in view of IEEE renders this claim obvious. The IEEE standard mandates a guard interval of 800 nanoseconds. *See* EX1008 at 21 (Table 79: “T_{GI}: GI duration” set at “0.8 μs” which is 800 nanoseconds), 36 (Table 86). As discussed in Claim 1[b][ii], Larsson expressly teaches that the cyclical shift of the OFDM packet is less than a sample duration of the guard interval. Thus, Larsson’s system would obviously have cyclically advanced the OFDM packet for a duration of less than 800 nanoseconds, which is the duration of the entire guard interval portion of the IEEE standard. *See* EX1003 ¶87.

It would have been obvious to a POSITA to apply the IEEE standard to the system of Larsson. *See* EX1003 ¶¶88-89. As a POSITA would have known, systems and methods that did not comply with the IEEE 802.11 standard were significantly less useful and valuable because they would presumptively not be compatible with other systems. *See id.* Non-standards-compliant systems were markedly less useful because customers who purchased non-standards-compliant equipment would be locked into a single supplier, which would create dependency risk for the customer and potentially preclude communications with other networks. *See id.* As a POSITA would have been aware, this is a very undesirable situation for customers, which is why standards are developed in the first place.

See id. Thus, it would have been obvious for Larsson to incorporate the 802.11 standard taught by IEEE.

A POSITA also would have had a reasonable expectation of success in doing so because complying with the IEEE standard would have been common and expected. *See id.* Indeed, it would have been expected of a POSITA to become familiar with the standard as part of their work experience because the standard underpinned the development of most commercial equipment. *See id.* Moreover, Larsson does not teach that its system is not compatible with the IEEE standard. In fact, Larsson is specifically built on the standard in view of its admitted prior art teachings in Figures 1-7 that align with the OFDM standard set forth in IEEE. *See* EX1005 at Figs. 1-7; EX1003 ¶¶88-89.

3. Claim 3

Larsson in view of IEEE renders this claim obvious. Larsson teaches a one sample shift and a three-sample guard interval duration. *See* EX1005 at Fig. 8. One half of a three-sample guard interval is 1.5 samples, so Larsson's one-sample shift teaches a cyclical shift of the first OFDM packet for a duration of less than one half of the sample duration of the guard interval. And as discussed above in Claim 1[b][i], this shift would be a cyclical advance in the asserted embodiment. *See* EX1003 ¶¶90-91.

4. Claim 4

Larsson in view of IEEE renders this limitation obvious. As a POSITA would have known and the '439 Patent admits, “there is a need to consider legacy receivers (e.g., single-input, single output (SISO), OFDM receivers),” because not all network participants upgrade their equipment at the same time; accordingly, the POSITA would have obviously accounted for those using legacy receivers, such as SISO receivers. *See* EX1001 at 1:27-29; EX1003 ¶¶92-93. The Applicant admitted such a system was prior art in (for example) Figure 1, and therefore a POSITA would have found it obvious and expected that a transmitter system such as Larsson in view of IEEE would be communicating with a legacy SISO receiver. *See* EX1001 at Fig. 1; EX1003 ¶¶92-93.

As the '439 Patent explains, two impulse responses are produced in response to a cyclic delay. *See* EX1001 at 4:11-22; EX1003 ¶¶94-96. The impulse responses caused by a cyclic delay “spoof” the receiver to believe it is seeing linear delay diversity (“LDD”), rather than cyclic delay, which appears as two different impulses in time. *See* EX1001 at 4:11-22 (noting that the impulse response is “indistinguishable from” Linear Delay Diversity in time); *see also* EX1011 at

36:22-37:30¹⁰, Fig. 3 (illustrating a plurality of impulse responses in a legacy receiver when cyclic delay diversity is applied in a legacy SISO receiver). As a result, the receiver shifts the FFT to the right because it uses the impulse responses to improperly center the guard interval, as it would in a Linear Delay Diversity system. *See* EX1001 at 4:16–19. This “erroneous” placement can cause the FFT to “spill[] over to the subsequent guard interval.” *See id.* at 4:20–22. Here, because Larsson’s teaching of cyclical advance would be applied (instead of cyclic delay), it would be the cyclical advancements that would lead to the plurality of impulse responses, for the same reasons that prior art cyclic delay would have led to the plurality of impulse responses. *See* EX1001 at 8:13-18; EX1003 ¶¶94-96. Thus, the “identical signal” created by Larsson’s cyclic advance would produce a plurality of impulse responses. *See* EX1001 at 8:13-18; EX1003 ¶¶94-96.

5. Claim 5

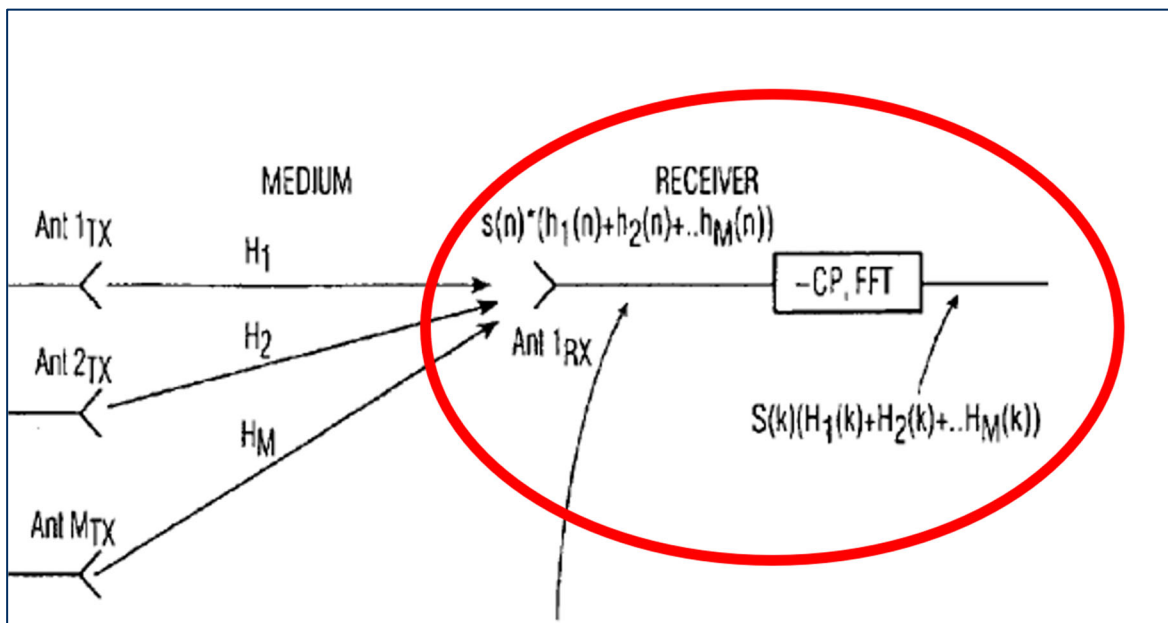
Larsson in view of IEEE renders this limitation obvious. The admitted prior art confirms that, with a cyclically delayed signal, the impulse response corresponding to the delayed version of the OFDM packet occurs later in time than the impulse response corresponding to the reference, unshifted OFDM packet. *See*

¹⁰ All page citations to EX1011 are to the sequentially stamped page at the bottom of the exhibit.

EX1001 at 3:30-38, 4:12-17, Fig. 4B; Claim 4; EX1011 at 36:22-37:30, Fig. 3; EX1003 ¶¶95, 97-99. Here, the cyclic shift is a cyclic advance as taught by Larsson; thus, as a POSITA would have expected, the impulse response associated with the cyclically advanced OFDM packet would occur earlier in time than the impulse response corresponding to the unshifted OFDM packet—the opposite of how the impulse response of a cyclically delayed packet appears later in time than the impulse response of the unshifted OFDM packet. *See* EX1003 ¶99.

6. Claim 6

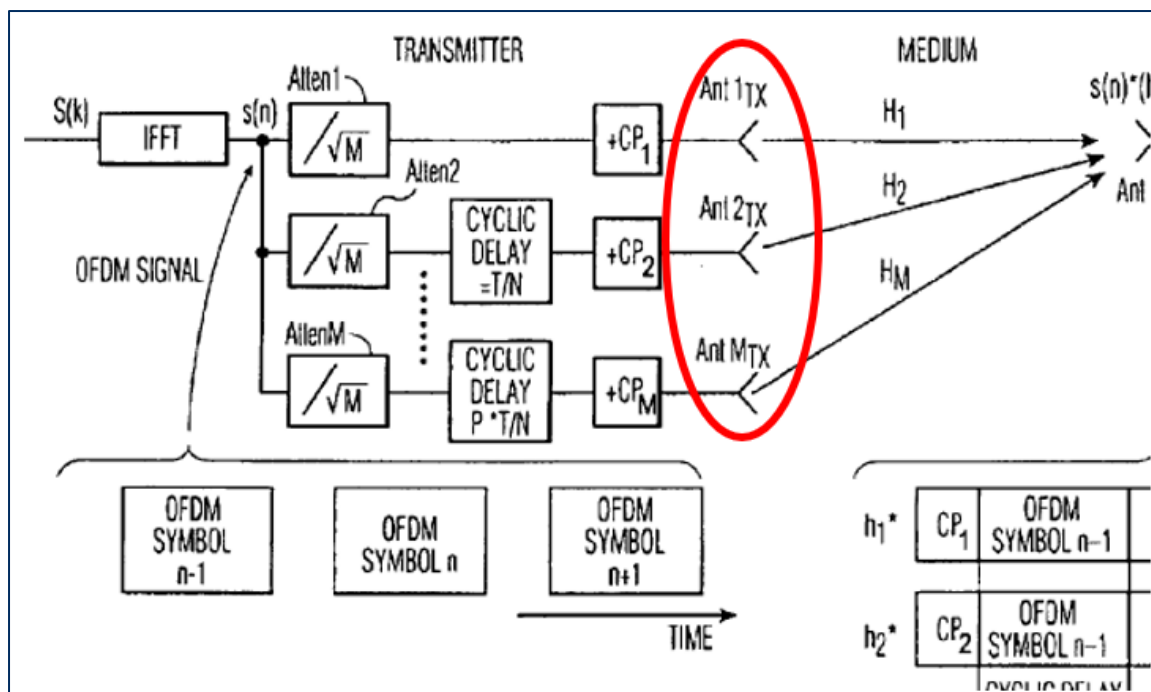
Larsson in view of IEEE renders this limitation obvious. *See* Claim 4. Larsson specifically contemplates using a single-input, single-output (SISO) receiver device:



See EX1005 at Fig. 9 (cropped, annotated), 9:56–60. Thus, a POSITA would have recognized that SISO is a legacy system compatible with Larsson in view of IEEE. See Claim 4; EX1001 at 1:27-29, Fig. 1; EX1003 ¶100.

7. Claim 7

Larsson in view of IEEE renders this limitation obvious. Larsson teaches that the original and shifted OFDM packets are “then transmitted through the respective antennas”, which can be seen, for example, in Larsson’s Figure 9 as “Ant” (short for antenna) TX (short for transmitter) numbered 1 through M:



See EX1005 at Fig. 9 (cropped, annotated), 7:10-11; EX1003 ¶101.

8. Claim 8

Larsson in view of IEEE renders this claim obvious.

a. Limitation 8[preamble]

Larsson teaches the preamble. *See* EX1003 ¶103. Larsson's signal transmitting system is shown, for example, in Larsson's Figure 9, and as discussed in Claim 1[preamble], that system effects a method for transmitting OFDM signals. *See* EX1005 at Fig. 9.

b. Limitation 8[a]

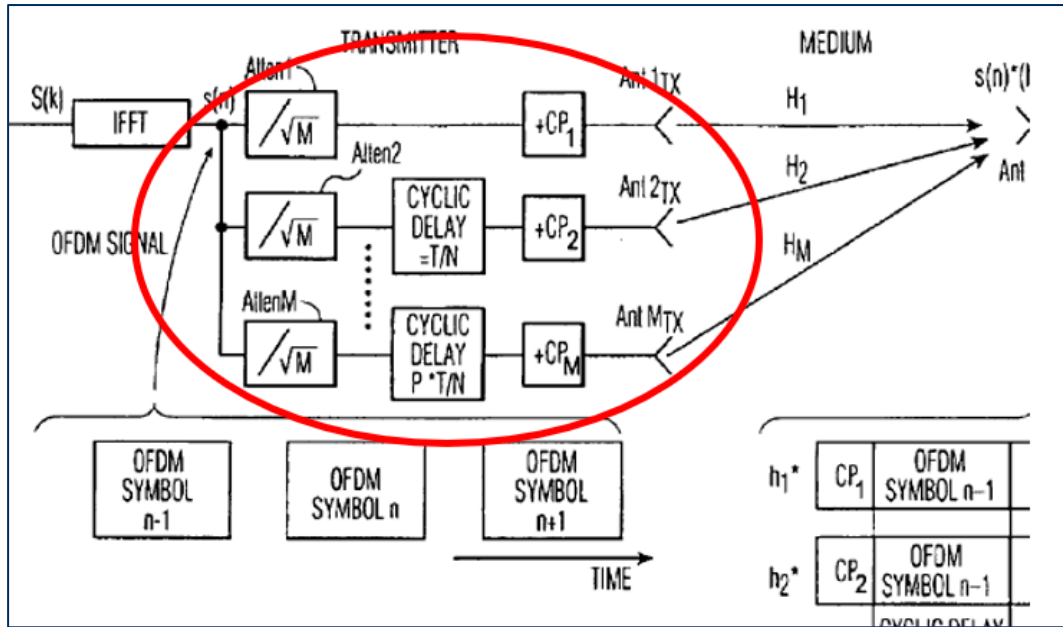
Larsson teaches, or at least renders obvious, this limitation. *See* EX1003 ¶104. As discussed above (incorporated herein) in Claim 1[a][i]-[ii], Larsson teaches generating a first OFDM packet for transmission including a guard interval portion and a symbol data portion each comprised of a plurality of samples. *See* § VII.A.1.b-c. There must have been, or at least obviously would have been, a processor to process the signal as taught by Larsson because otherwise the signal could not be processed as Larsson teaches. *See* EX1003 ¶104 (discussing, for example, EX1007 at, *e.g.*, 4:21-22: "transmit diversity provided by a *processing* of the transmit signal"). And that processor is a transmit processor because it processes the signal for transmission. *See id.*

c. Limitation 8[b]

Larsson in view of IEEE renders this limitation obvious. *See* EX1003 ¶¶105-07. As discussed above (incorporated herein) in the context of Claim 1[b][i]-[iii], Larsson in view of IEEE renders obvious 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 samples from the guard interval portion of the first OFDM packet are shifted out of the guard interval portion of the shifted version. *See* § VII.A.1.d-f. A POSITA would understand that such functions are performed by a second transmit processor that processes the signal for transmission because there must have been, or at least obviously would have been, a processor to process Larsson's shifted signal. *See* EX1003 ¶¶105-06. And that second processor is a second transmit processor because it processes the signal for transmission. *See id.*

The “first transmit processor” is the code that generates the first OFDM packet in accordance with Claim 8[a], while the “second transmit processor” is the code that generates the shifted version of the first OFDM packet in accordance with Claim 8[b]. These obviously would have been different code modules, for at least two reasons. **First**, Larsson teaches that the cyclic shift is performed separately in “each [different] antenna path,” and there are multiple such paths distinctly illustrated:



See EX1005 at Fig. 9, 7:64-66. A POSITA would therefore have understood Larsson to teach separate code modules for “each” antenna path rather than one module for every path; otherwise, the figures would have been diagrammed differently. See *id.*; EX1003 ¶¶105-06. **Second**, as a POSITA would recognize, different code modules could be processed in parallel and thus more quickly. See EX1003 ¶¶106-07. Having two different code modules for the two transmit processors would increase the system’s speed, by processing in parallel. See *id.*

The ’439 Patent does not require that the claimed “first transmit processor” and “second transmit processor” be two physically separate processor devices. Compare EX1001 at 9:11-14 (“Any process descriptions or blocks in flow charts should be understood as representing modules, segments, or portions of code”) with, e.g., *id.* at Fig. 6 (two transmit processors depicted as blocks in flow chart

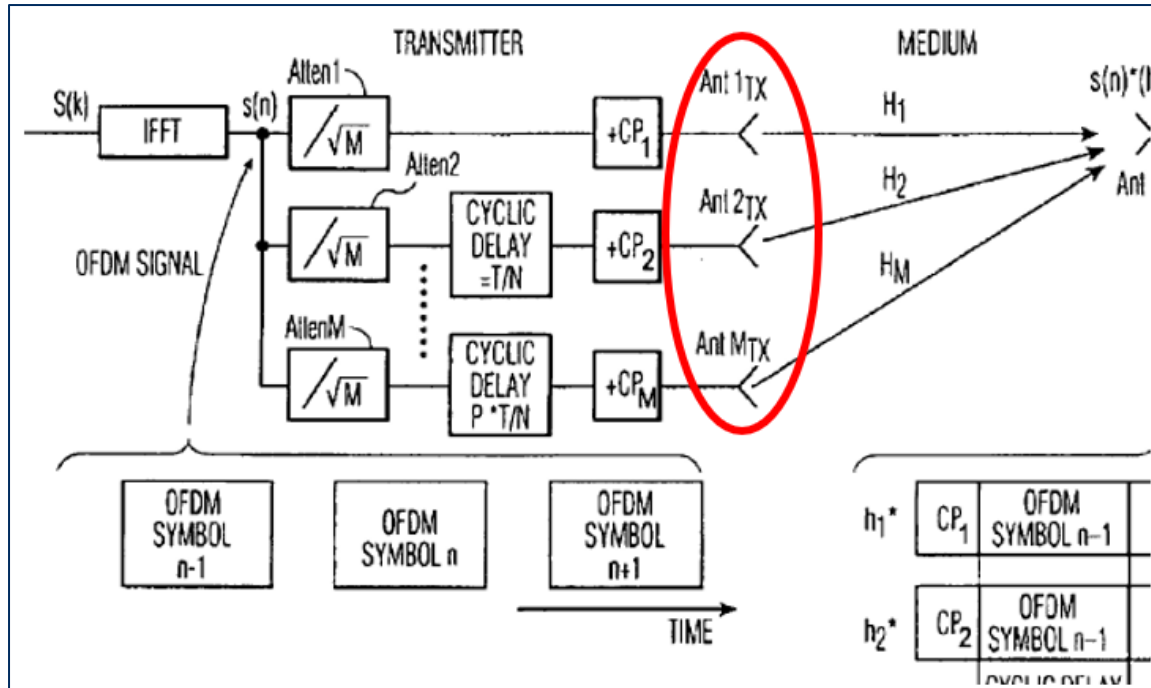
showing data flow); *see also id.* at 6:6-8 (“Module 604 comprises a transmit (TX) processor 608, which includes baseband processing modules (i.e., logic, such as hardware and/or *software*)....”). But if this limitation is construed to require physically distinct transmit processors, Larsson in view of IEEE renders this obvious. As shown above in Larsson’s Figure 9, the shifted OFDM packet is generated separately on a different “antenna path” and transmitted by a different physical antenna, apart from the first (non-shifted) OFDM packet. Thus, a POSITA would have understood, or at least found obvious, that Larsson was suggesting the use of physically separate transmit processors associated with physically separate antennas. *See* EX1003 ¶¶105-07. Additionally, as a POSITA would have known and been motivated to try, distinct physical transmit processors would increase the system’s speed with additional processing power. *See id.* Moreover, as a POSITA would have known, it was common in the art to use multi-antenna transmitter devices. *See id.* And because the different physical processors would simply be implementing two code modules on two pieces of hardware, a POSITA would have had a reasonable expectation of success because there is no reason the code must be implemented on one physically singular processor, and further because it was common to implement them in this manner. *See id.*

d. Limitation 8[c]

Larsson in view of IEEE renders this limitation obvious. *See* EX1003 ¶108. Larsson's system is a "radio communication system," so its signals must be converted into radio signals. *See* EX1005 at, *e.g.*, cl. 1. IEEE teaches a multi-step transmission process, and after completing the creation of the OFDM packets in step (m), IEEE teaches step (n) for up-converting the OFDM packets from "baseband" to "RF" (radiofrequency). *See* EX1008 at 20. A POSITA would understand this a conversion of all generated OFDM packets to radiofrequency, or RF, signals for transmission. *See* EX1003 ¶108. And as shown in Larsson's Figure 9, this would require a plurality of radio transmitters, one for each antenna shown in Figure 9 because "each" OFDM packet proceeds along its own "antenna path." *See* EX1005 at Fig. 9, 7:62-64.

e. Limitation 8[d]

Larsson teaches this limitation. *See* EX1003 ¶109. The plurality of radio antennas can be seen in Larsson's Figure 9, described as "Ant" (antenna) TX (transmitter) numbered 1 through M:



See EX1005 at Fig. 9 (cropped, annotated), 7:10-11; EX1003 ¶109. H_1 through H_M depict signal transmission. See EX1005 at Fig. 9, 8:5-6 (“transmits the symbols from the various antennas”). A POSITA would understand that the signals are radio signals because Larsson’s system is a “radio communication system.” See *id.* at cl. 1; EX1003 ¶109. And each of these radio antennas would be correspondingly coupled to the plurality of radio transmitters that converted the OFDM packets into radio signals in the first place, as that is how the radio antennas obtain the radio signals and because each radio antenna is on its own, distinct “antenna path.” See EX1005 at Fig. 9, 7:61-62; EX1003 ¶109.

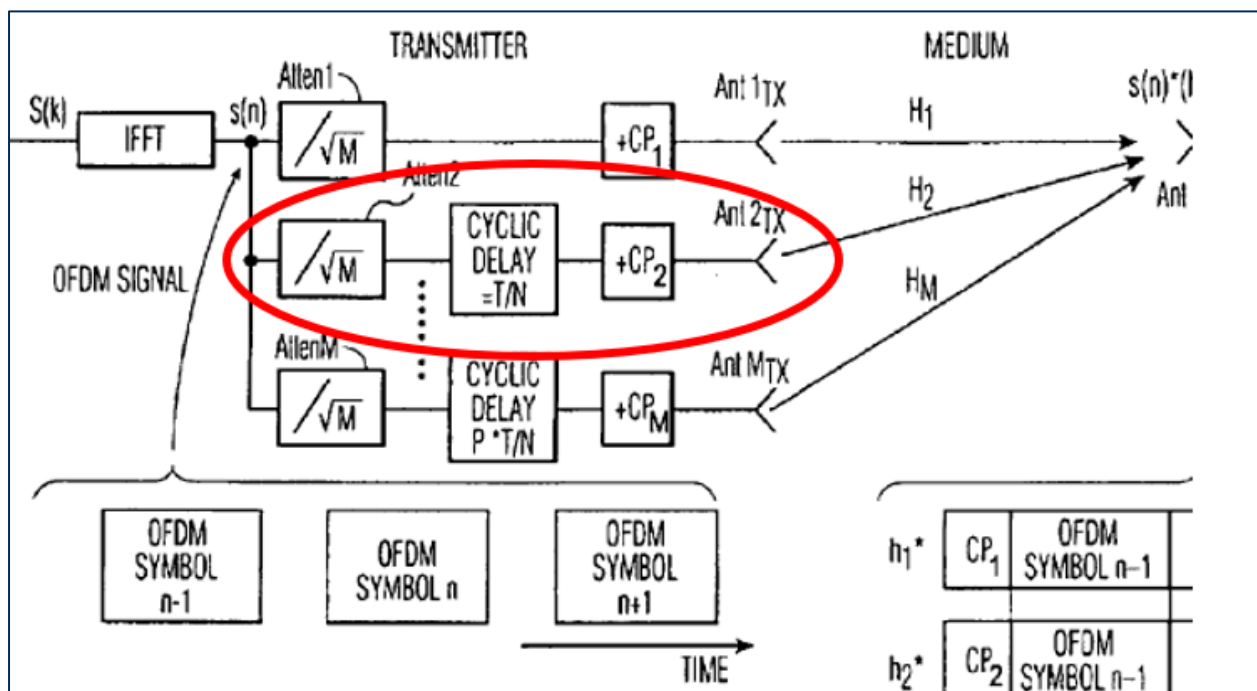
f. Limitation 8[e]

Larsson teaches this limitation. See EX1003 ¶110. As discussed above (incorporated herein) in the context of Claim 1[c], Larsson teaches substantially

simultaneously transmitting the first OFDM packet and the shifted version of the OFDM packet. *See* § VII.A.1.g. The system components that are configured to substantially simultaneously cause that transmission are the first transmit processor and the second transmit processor, since those are the processors that generate the first OFDM packet and the shifted version of the OFDM packet, as discussed in Claim 8[a] and [b]. These packets are transmitted via corresponding transmitters and antennas, as illustrated. *See* EX1005 at Fig. 9; EX1003 ¶110.

9. Claim 9

Larsson in view of IEEE renders this claim obvious. As can be seen, for example, in Larsson's Figure 9, "each antenna path" is processed by its respective transmit processor, and that includes a cyclic extension module for performing cyclic shifts:



See EX1005 at Fig. 9 (cropped, annotated) at 7:64-8:5 (“In *each* antenna path the samples are shifted one sample point.... In *each* antenna path after the samples have been shifted, a cyclic prefix is added....”); EX1003 ¶¶111-17. Although the cyclic extension module in Larsson’s Figure 9 is illustrated as performing a cyclic delay, in the asserted (but unillustrated) embodiment of Larsson that shifts packets in the other direction, the cyclic extension module would perform cyclic advancements.

The cyclic extension module for performing cyclic shifts associated with the first transmit processor is not expressly illustrated in Larsson’s Figure 9. However, the first transmit processor does still add a cyclic prefix. See EX1005 at 8:3-4. And although its application for cyclic shifting is not illustrated (because there is no cyclic shift of the first OFDM packet itself), the cyclic extension module would at least obviously have had such ability. As a POSITA would have recognized, systems were not designed with one single dedicated antenna for the unshifted reference signals because doing so would hamper the system’s flexibility. See EX1003 ¶¶113-17. Thus, as a POSITA would have known, every pathway in the antenna system would generally have been, and would obviously have been, equipped with the ability to cyclically shift, even though the cyclical shift applied on any particular antenna pathway might be zero in a specific circumstance. See *id.* (discussing, for example, EX1012 at Fig. 8A, which shows a module for

performing a “Circular Shift by 0 Sample”). A POSITA also would have found this obvious because the system might chose to apply a cyclic shift to every signal, as the Examiner recognized during prosecution. *See* EX1002 at 1051 (“It would have been obvious ... to use shifting of OFDM symbols on all paths of the system ... as a design choice....”).

10. Claim 10

Larsson in view of IEEE renders this claim obvious. As discussed above (incorporated herein) in the context of Claim 3, Larsson in view of IEEE renders obvious cyclically advancing the OFDM packet for a duration of less than one half of the sample duration of the guard interval. This Claim 10 is the system counterpart to method Claim 3, and it is the cyclic extension modules identified in Claim 9 that perform the method steps claimed in Claim 3. Larsson teaches configuring each of the cyclic extension modules corresponding to the first and second transmit processors to shift one sample, which is less than half of the 3-sample guard interval, thus satisfying this claim. *See* EX1005 at 7:64-8:5 (“In *each* antenna path the samples are shifted one sample point....”); EX1003 ¶118.

11. Claim 11

Larsson in view of IEEE renders this claim obvious. As discussed above in the context of Claim 2, Larsson in view of IEEE would be configured to cyclically advance the OFDM packet for a duration of less than -approximately 800

nanoseconds, as taught by IEEE in order to comply with the standard. Each of the cyclic extension modules in the system of Larsson in view of IEEE would therefore obviously have been so configured. It makes no sense to have some cyclic extension modules comply with the IEEE standard while others do not. *See* EX1003 ¶119.

12. Claim 12

Larsson in view of IEEE renders this claim obvious. Larsson teaches that a POSITA would have “recognized that to reduce the effects of channel impairments on a transmitted signal ... interleaving can be performed on the transmitted signal.” *See* EX1005 at 8:10-13. IEEE confirms that “[a]ll encoded data bits *shall* be interleaved.” *See* EX1008 at 29. IEEE describes this interleaving in its overview, indicating that the received data is interleaved into a plurality of sub-carrier channels. *See id.* at 20 (noting that the “interleaved data” in step (i) is subsequently “mapped hereafter into OFDM *subcarriers* numbered [listing the plurality of sub-carrier numbers]”). Therefore, the claimed interleaving would have been expected by, and obvious to, a POSITA to ensure that Larsson’s system complied with the IEEE standard. *See* EX1003 ¶¶120-22.

13. Claim 13

Larsson in view of IEEE renders this claim obvious. Larsson teaches that in a “conventional” OFDM system, the “transmitter takes a symbol $S(k)$ and performs

an inverse fast Fourier transform (IFFT) to convert the symbol to be transmitted from the frequency domain into the time domain.” *See* EX1005 at 1:34-37. Such interleaving was well-known, such that Larsson incorporated it to generate the OFDM symbols for transmission. *See id.* at, *e.g.*, cl. 5. IEEE confirms that IFFT was the “common way to implement” this process of taking incoming data (processed upstream in other ways) and generating the OFDM symbols from that data, and that it would have been done by “each” transmit processor. *See* EX1008 at 23, 20 (“For *each* group of subcarriers -26 to 26, convert the subcarriers to time domain using inverse Fourier transform”); EX1003 ¶¶123-24.

14. Claim 14

Larsson in view of IEEE renders this claim obvious. IEEE teaches that first the OFDM symbol is created, to which the shift is applied, and only then is the signal up-converted from “baseband” to “RF” (radiofrequency). *See* EX1008 at 20. Thus, the transmit processors must perform their cyclical shifts on baseband signals, as a POSITA would have expected. *See* EX1003 ¶¶125-26.

15. Claim 15

Larsson in view IEEE renders this claim obvious. As a POSITA would have been aware, an ASIC is a specialized type of processor that implements instructions. *See* EX1003 ¶¶127-28. The transmit processor must be implemented on a physical processor, and an ASIC was an obvious choice (among a very limited

set of fundamental processor types, such as CPUs, GPUs, FPGAs, and ASICs) to a POSITA for its speed. *See id.* (citing, *e.g.*, EX1013 ¶26). Indeed, during prosecution, the Examiner took official notice “that using ASIC ... [is] well known and expected in the art” and that it “would have been obvious to ... to [] us[e an] ASIC ... to implement” processing requirements in systems such as Larsson’s. *See* EX1002 at 1053.

16. Claim 16

Larsson in view of IEEE renders this claim obvious. As discussed in Claim 2, a POSITA would have been highly motivated to ensure that Larsson’s system complied with the IEEE 802.11 standard. And a POSITA would have understood that Larsson’s teaching of cyclical advancement, as an alternative to cyclical delay, would not have affected its compliance, including because, as the ’439 Patent recognizes, a small advance versus a large delay is “identical ... from the perspective of the” receiver. *See* EX1001 at 8:5-18; EX1003 ¶¶129-30.

17. Claim 17

Larsson in view of IEEE renders this claim obvious. As a POSITA would have been aware, an FPGA is a specialized type of processor that is effective at implementing instructions. *See* EX1003 ¶¶131-32. The transmit processor must be implemented on a physical processor, and an FPGA was an obvious choice to a POSITA for its speed. *See id.* Indeed, during prosecution, the Examiner took

official notice “that using [] FGPA ... [is] well known and expected in the art” and that it “would have been obvious ... to [] us[e an] FPGA ... to implement” processing requirements in systems such as Larsson’s. *See* EX1002 at 1053.

18. Claim 18

Larsson in view of IEEE renders this claim obvious. As a POSITA would have been aware, using firmware stored in a memory device that is executed by a suitable instruction execution system is a common way to use a CPU. *See* EX1003 ¶¶133-34. The transmit processor must be implemented on a physical processor, and firmware was an obvious choice to a POSITA because CPUs were ubiquitous and inexpensive, and also because programming such firmware was a basic part of a POSITA’s computer science knowledge. *See id.* Indeed, during prosecution, the Examiner took official notice “that using ... firmware stored in a memory ... [is] well known and expected in the art” and that it “would have been obvious ... to [] us[e] firmware stored in a memory ... to implement” processing requirements in systems such as Larsson’s. *See* EX1002 at 1053.

19. Claim 19

Larsson in view of IEEE renders this claim obvious.

a. 19[preamble]

Larsson teaches the preamble. *See* Claim 8[preamble]; EX1003 ¶136.

a. 19[a]

Larsson in view of IEEE renders this limitation obvious. *See* EX1003 ¶137. Referencing Claim 8[a], the algorithm by which the transmit processor for generating a first OFDM packet would generate that packet is disclosed in the IEEE 802.11 standard because it would have been obvious for Larsson's system to comply with the IEEE 802.11 standard. *See* Claim 16; EX1003 ¶129-30.

a. 19[b]

Larsson in view of IEEE renders this limitation obvious. *See* Claim 8[b]; EX1003 ¶¶105-07, ¶138.

a. 19[c]

Larsson in view of IEEE renders this limitation obvious. *See* EX1003 ¶139. Referencing Claim 8[c], the algorithm by which the radio transmitters would convert those packets is that disclosed in the IEEE 802.11 standard because it would have been obvious for Larsson's system to comply with the IEEE 802.11 standard. *See* Claim 16; EX1003 ¶139.

a. 19[d]

Larsson in view of IEEE renders this limitation obvious. *See* EX1003 ¶140. Referencing Claim 8[e], the algorithm by which the transmit processors would cause substantially simultaneous transmission is that disclosed in the IEEE 802.11 standard because it would have been obvious for Larsson's system to comply with the IEEE 802.11 standard. *See* Claim 16; EX1003 ¶140.

20. Claim 20

Larsson in view of IEEE renders this claim obvious. *See* Claims 3, 10. As discussed above (incorporated herein) in the context of Claim 3, Larsson in view of IEEE renders obvious a cyclic advance with a duration less than one of half of [sic] sample duration of the guard interval of the OFDM packet because Larsson teaches a one sample shift, with a three-sample guard interval. *See* EX1005 at 7:64-8:5; EX1003 ¶141.

21. Claim 21

Larsson in view of IEEE renders this claim obvious. *See* Claim 4. Referencing Claim 4, Larsson in view of IEEE renders obvious a legacy receiver because as a POSITA would have been aware and the '439 Patent admits, “there is a need to consider legacy receivers (e.g., single-input, single output (SISO), OFDM receivers),” because not all network participants upgrade their equipment at the same time; accordingly, the POSITA would have obviously accounted for participants in the wireless network using legacy receivers. *See* EX1001 at 1:27-29; EX1003 ¶142-43.

Cyclical advancements, as delays, cause the legacy receiver to produce a plurality of impulse responses in an acquisition process, and each of the first OFDM packet and the shifted version of the OFDM packet would correspond to one of the plurality of impulse responses because the impulse response “is

indistinguishable from ... linear delay diversity.” EX1001 at 4:5-22, EX1003 ¶¶142-43.

B. Ground II: Claims 1-21 Are Obvious Over Kaiser In View Of Bauch And IEEE

1. Claim 1

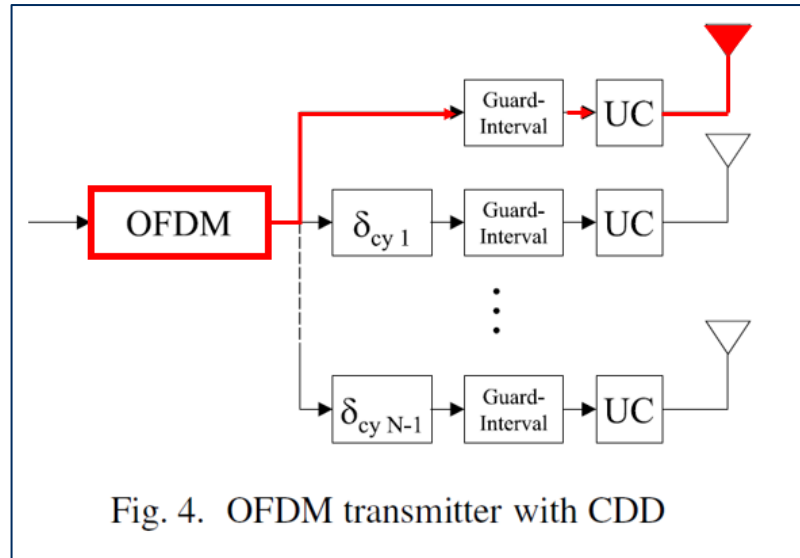
Kaiser in view of Bauch and IEEE renders obvious Claim 1.

a. Limitation 1[preamble]

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.

b. Limitation 1[a][i]

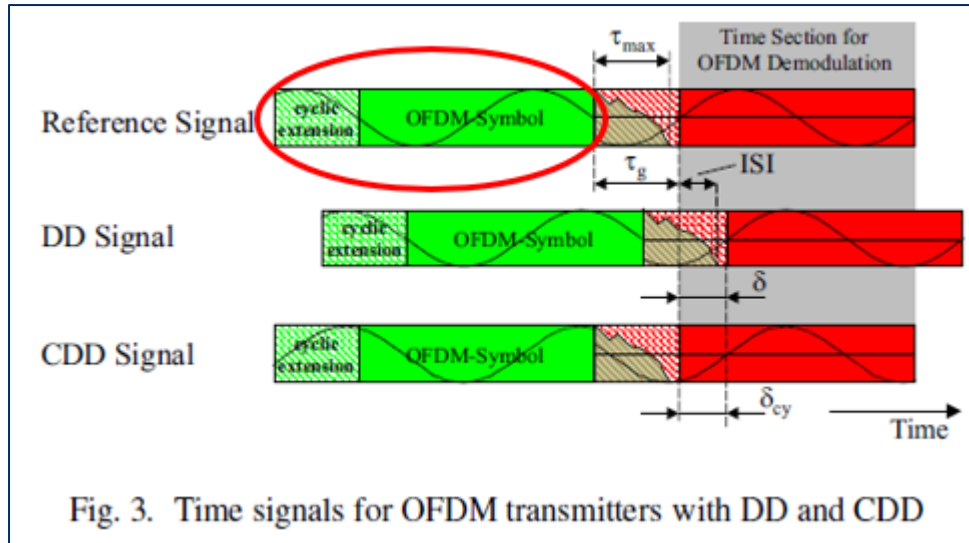
Kaiser teaches this limitation. *See* EX1003 ¶¶146-47. For example, Kaiser’s Figure 4 shows a first OFDM packet that is generated, which proceeds onwards to the antenna (red-annotated triangle):



See EX1006 at Fig. 4 (annotated); EX1003 ¶147. The process of generating this first OFDM packet would have been known to a POSITA and is described, for example, in Kaiser’s Figure 9. See EX1006 at Fig. 9; EX1003 ¶147. A POSITA 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. See EX1006 at, e.g., 5 (discussing decreasing “the occurrence of *packet* errors”); EX1003 ¶146-47.

c. Limitation 1[a][ii]

Kaiser teaches this limitation. See EX1003 ¶¶148-50. For example, in Kaiser’s Figure 3, the “Reference Signal” (the first OFDM packet generated), includes an “OFDM Symbol” data portion and a “cyclic extension” prepended:



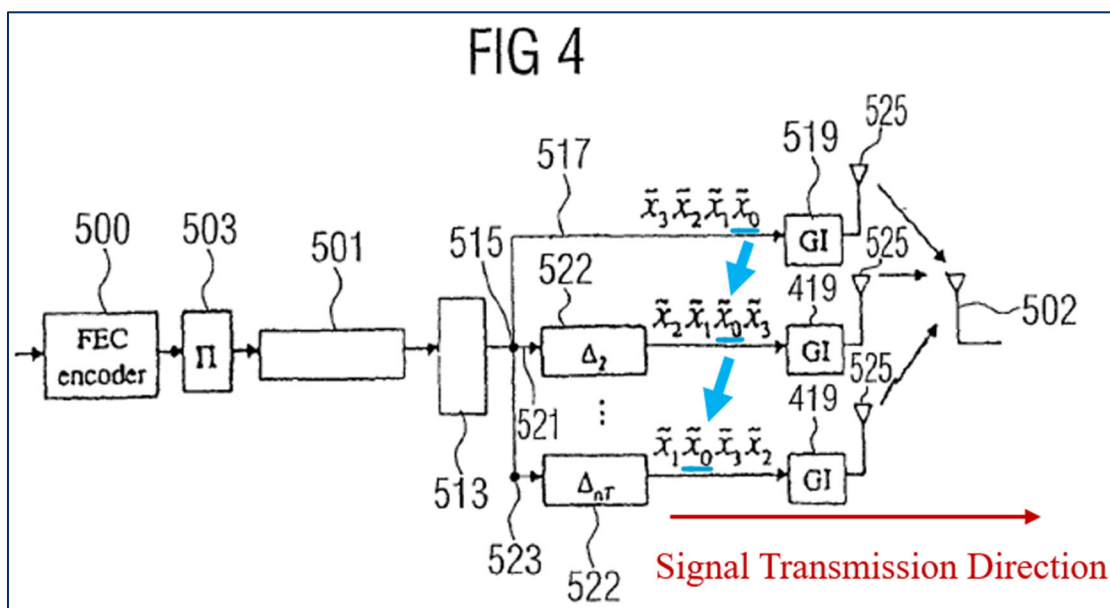
See EX1006 at Fig. 3 (annotated). Kaiser explains that the prepended “cyclic extension” serves as a “guard interval.” See *id.* at 2; see also EX1001 at, e.g., 3:1-2 (admitting that “guard intervals [are] created as cyclic extensions”).

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.

d. Limitation 1[b][i]

Kaiser in view of Bauch and IEEE renders this limitation obvious. *See* EX1003 ¶151-56. Kaiser teaches cyclically delaying (but not cyclically advancing) the first OFDM packets by shifting the samples in a direction. For example, Kaiser teaches “applying a cyclic time shift of δ_{cy} .” *See* EX1006 at 2. As a POSITA would recognize and as the ’439 Patent admits was prior art, this is a cyclic delay, which involved cyclically delaying the first OFDM packet by shifting the samples in a first direction. *See* Ex.1001 at, *e.g.*, Fig. 5, 3:50-4:4; EX1003 ¶152.

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:



See EX1007 at Fig. 4 (annotated), 22:23-23:2 (showing a “one coefficient” shift¹¹). 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 OFDM 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.

A POSITA would have been motivated to apply Bauch’s teachings to Kaiser and would have had a reasonable expectation of success in doing so for a number

¹¹ As a POSITA would recognize, shifting “coefficients” corresponds to shifting “samples” in view of how coefficients are mapped to samples pursuant the IEEE standard. See EX1003 ¶¶45-49, 153-54 (explaining the standard’s mapping of “coefficients” to 64 IFFT inputs, and then producing time-domain “samples” by performing the IFFT); EX1008 at 23-24, 86.

of reasons. Most saliently, 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 conformable 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" (cyclical 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.

A POSITA also would have been motivated to apply Bauch's teaching 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—

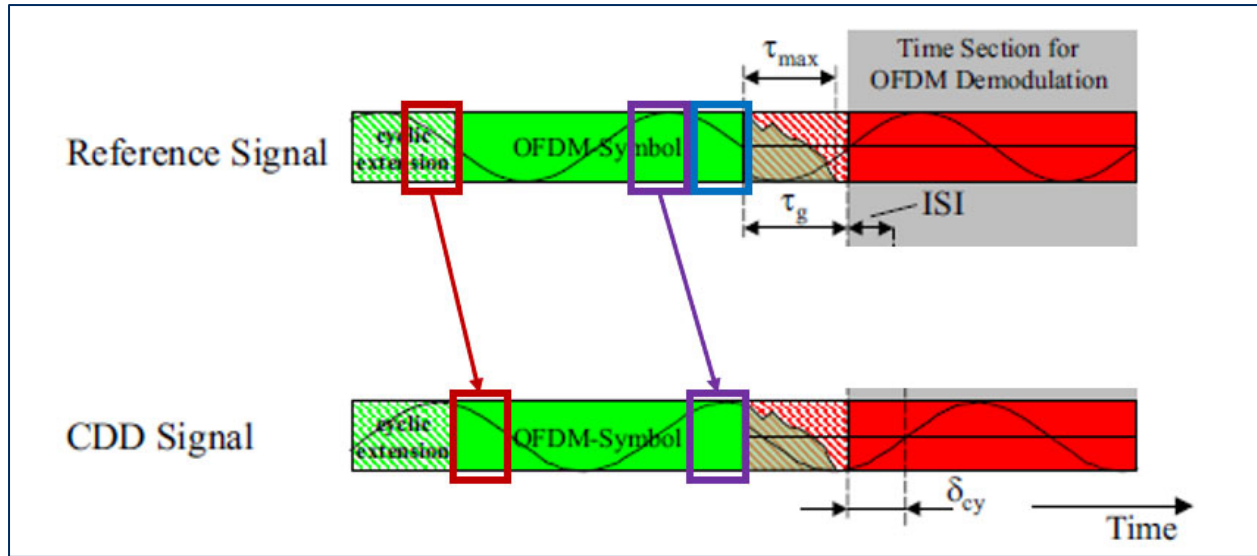
there is no difference when the shifts' magnitudes are correspondingly aligned. *See* EX1007 at 22:30-23:1. They are both equally acceptable, and both expressly contemplated by Bauch as being applied to Kaiser's system. *See id.*; Ex. 1003, ¶¶151-56.

e. Limitation 1[b][ii]

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.

f. Limitation 1[b][iii]

Kaiser in view of Bauch and IEEE renders this limitation obvious. *See* EX1003 ¶¶158-59. In Kaiser's cyclic delay shift, a non-zero number of **samples from the guard interval are shifted into the symbol data portion**, which **shifts the same number of samples towards the end**, which **shifts the same number of samples out**:

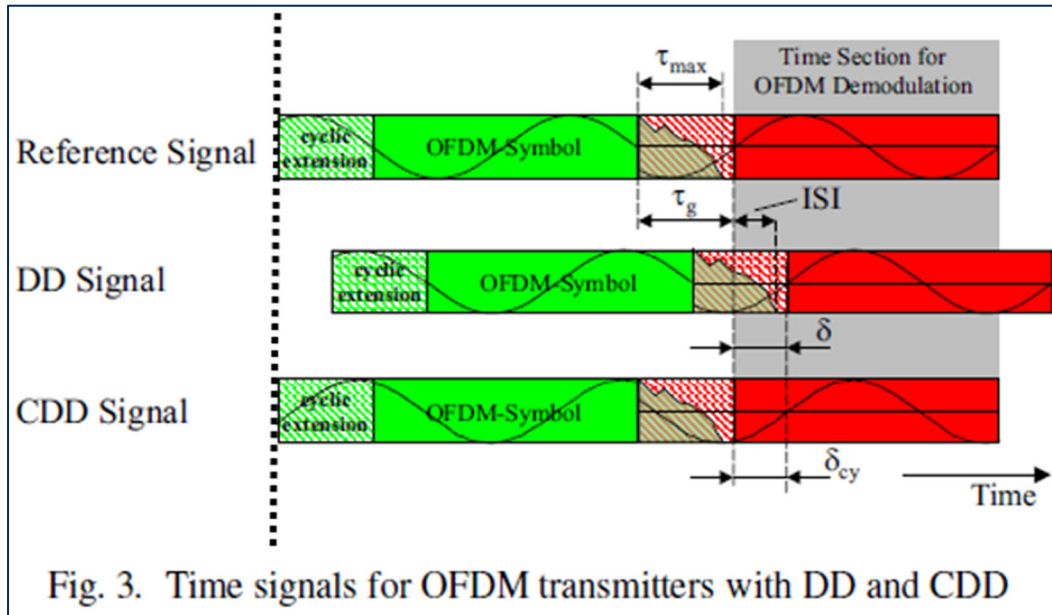


See EX1006 at Fig. 3 (annotated, modified); EX1003 ¶159. When Bauch's teaching of cyclic advance is applied to Kaiser, the shift would be in the opposite direction: A non-zero number of samples from the symbol data portion would be shifted into the guard interval, and the same non-zero number of samples from the guard interval would be shifted out. Kaiser expressly teaches that the shift in the guard interval and the symbol data is the same magnitude, δ_{cy} . See EX1006 at 2. The '439 Patent also admits that shifts of the same number of samples was well-known. See EX1001 at Fig. 5; EX1003 ¶159.

g. Limitation 1[c]

Kaiser teaches this limitation. See EX1003 ¶¶160-61. As shown, for example, in Kaiser's Figure 3, both the Reference Signal (the first, unmodified OFDM packet) and the CDD Signal (the cyclically shifted version of the first

OFDM packet) are sent simultaneously in time, in contrast to the time-delayed Delay Diversity Signal (DD Signal):



See EX1006 at Fig. 3 (annotated). Bauch confirms that a POSITA would understand that Kaiser’s “cyclic delay diversity may be applied for transmitting data *simultaneously* from different transmit antennas.” See EX1007 at 4:24-28 ; EX1003 ¶161.

2. Claim 2

Kaiser in view of Bauch and IEEE renders this claim obvious. The IEEE standard mandates an 800 nanosecond guard interval. See EX1008 at 21, 36. As discussed in Claim 1[b][ii], Kaiser and Bauch both expressly teach that the cyclical shift of the OFDM packet would be for an amount less than a sample duration of the guard interval. Thus, while using a compliant, 800 nanosecond guard interval, Kaiser’s system would obviously have cyclically advanced the OFDM packet

(given Bauch's teachings) for a duration of less than 800 nanoseconds (given IEEE's teachings). *See* EX1003 ¶¶162-64.

It would have been obvious to a POSITA to apply the IEEE standard to the system of Kaiser and Bauch. *See* EX1003 ¶¶163-64. As a POSITA would have known, systems and methods that did not comply with the IEEE 802.11 standard were significantly less useful and valuable for the same reasons as described above in Section VII.A.2. *See* EX1003 ¶¶163-64. Thus, it would have been obvious for the system of Kaiser and Bauch to incorporate the 802.11 standard taught by IEEE.

A POSITA also would have had a reasonable expectation of success in doing so, because Kaiser's system is expressly intended to and does comply with the IEEE 802.11 standard. *See* EX1006 at, *e.g.*, Abstract, 6 ("The presented antenna diversity schemes can be easily implemented in existing OFDM systems without changing the standards or the receivers."); EX1003 ¶164.

3. Claim 3

Kaiser in view of Bauch and IEEE renders this claim obvious. Bauch teaches shifting just a single coefficient, which as explained above, maps to a single time-domain sample. *See* EX1007 at 22:30-23:1; EX1003 ¶¶165-66. Even the '439 Patent admits that cyclical shifts of one sample were known in the art. *See* EX1001 at Fig. 5. In the system of Kaiser in view of Bauch and IEEE, such shift would be a cyclical advance of the OFDM packet of one sample, as explained in Claim 1[b][i].

And as the '439 Patent admits was part of the IEEE prior art standard, the guard interval portion was 16 samples. *See* EX1001 at 2:26-30; EX1003 ¶166. Cyclically advancing the OFDM packet by just one sample is less than the duration of one half of the sample duration of guard interval (8 samples), such that this limitation is satisfied. *See* EX1003 ¶166.

4. Claim 4

Kaiser in view of Bauch and IEEE renders this limitation obvious. *See* EX1003 ¶¶167-68. A POSITA would have been motivated to incorporate the legacy SISO receiver depicted in the '439 Patent's Figure 1 admitted prior art, as well as all of the known and admitted prior art operation of that receiver with respect to impulse responses, into the system of Kaiser in view of Bauch and IEEE for the same reasons as a POSITA would have been motivated to do so with the system of Larsson and IEEE, and would have had the same expectation of success. *See* Ground I, Claim 4; EX1003 ¶167-68.

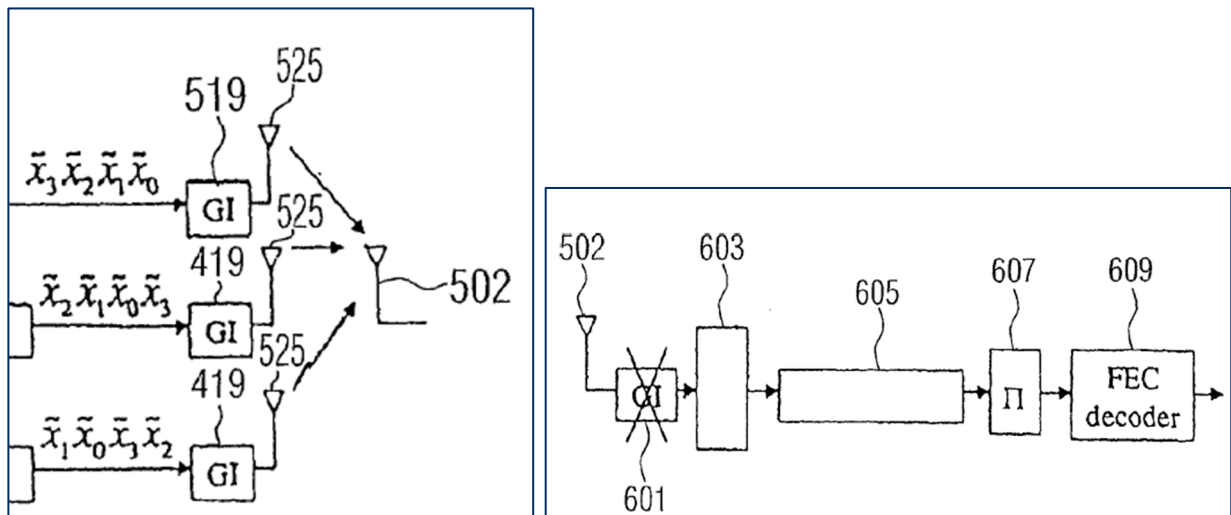
5. Claim 5

Kaiser in view of Bauch and IEEE renders this limitation obvious. The analysis is essentially the same as in Ground I, Claim 5 (incorporated herein by reference), since the legacy SISO receiver incorporated in both grounds is the same one that is taught in the '439 Patent's Figure 1 AAPA, which operates the same way in both grounds (as a POSITA would have known and is explained, for

example, in the AAPA related to the '439 Patent's description of Figure 4B). See EX1003 ¶¶169-70.

6. Claim 6

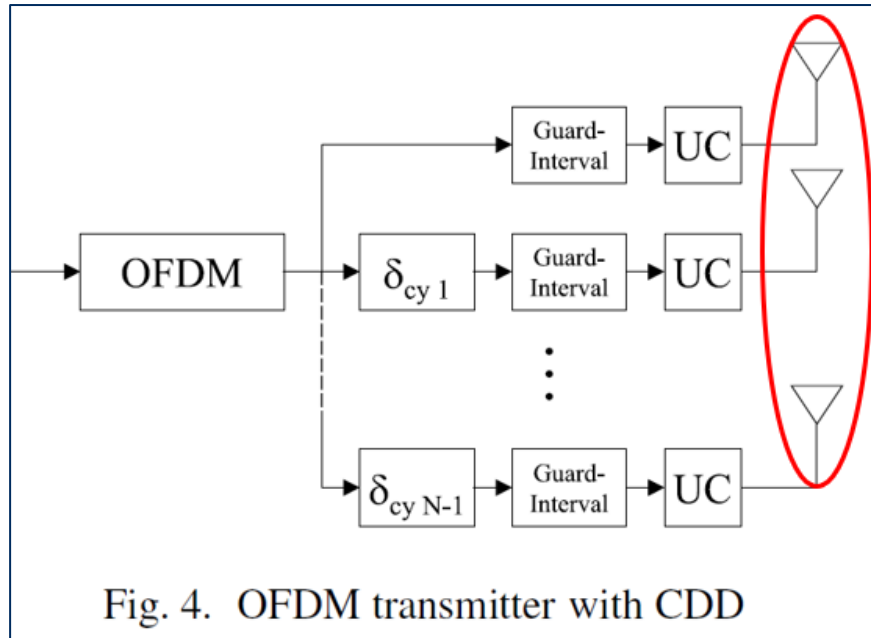
Kaiser in view of Bauch and IEEE renders this limitation obvious because Bauch also teaches a legacy SISO receiver device with receiver antenna 502:



EX1007, 4:28–29 (“At the receiver, a single receive antenna ... can be applied.”), Figs. 4 and 5 (cropped). The analysis is therefore substantially the same as in Ground I, Claim 6; EX1003 ¶171.

7. Claim 7

Kaiser in view of Bauch and IEEE renders this limitation obvious. The Reference Signal (first OFDM packet) and the CDD Signal (cyclically shifted version) in Kaiser's Figure 3 are transmitted by a multiple-antenna transmitter device that has *N* number of antennas:



See EX1006 at Fig. 4 (annotated); *id* at 2 (“The OFDM modulated signal is transmitted over N antennas, whereas the particular signals only differ in an antenna specific cyclic shift.”); EX1003 ¶172.

8. Claim 8

Kaiser in view of Bauch and IEEE renders this claim obvious.

a. Limitation 8[preamble]

Kaiser teaches the preamble. See EX1003 ¶174. For example, Kaiser teaches that its “Fig. 4 shows ... an N -transmitter-antenna OFDM system with CDD. The OFDM modulated signal is transmitted over N antennas....” See EX1006 at 2.

b. Limitation 8[a]

Kaiser teaches, or at least renders obvious, this limitation. See EX1003 ¶175. As discussed (incorporated herein) in Claim 1[a][i]-[ii], Kaiser teaches generating a first OFDM packet for transmission including a guard interval portion and a

symbol data portion each comprised of a plurality of samples. *See* § VII.A.1.b-c. There must have been, or at least obviously would have been, a processor in order to process the signal as taught by Kaiser because otherwise the signal could not be processed. *See* EX1003 ¶175. And that processor is a transmit processor because it processes the signal for transmission. *See id.* Bauch confirms that the system contains a transmit processor to process the signal as taught by Kaiser and Bauch. *See* EX1007 at, e.g., 4:21-22 (discussing “*processing* ... the transmit signal”).

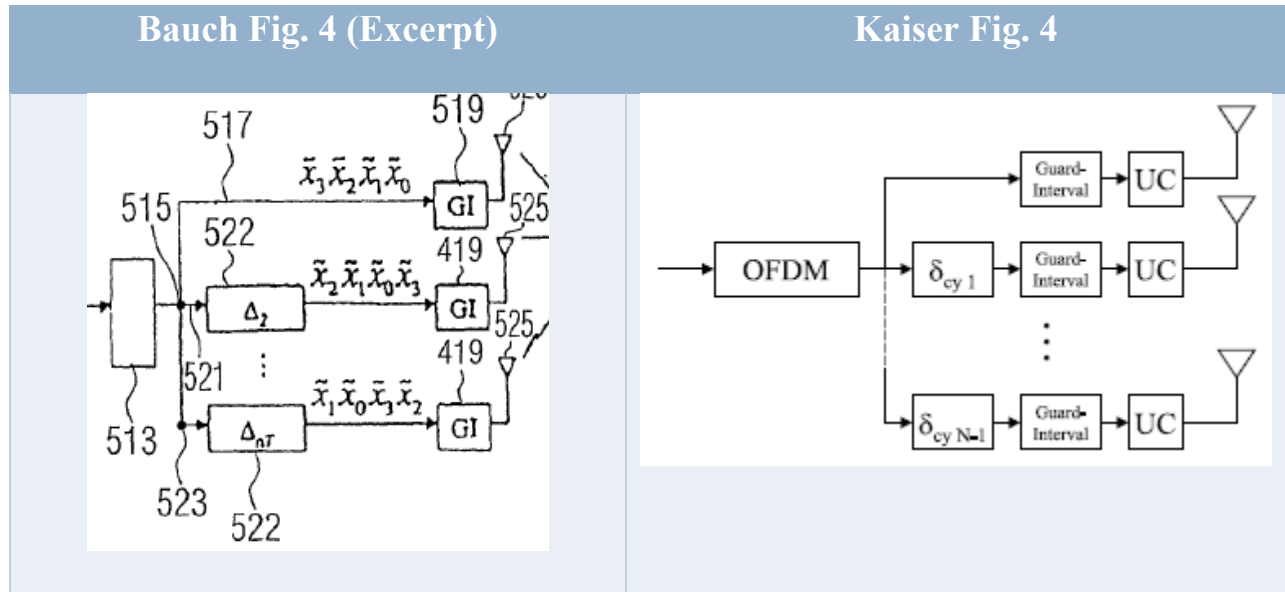
c. Limitation 8[b]

Kaiser in view of Bauch and IEEE renders this limitation obvious. *See* EX1003 ¶¶176-79. As (incorporated herein) in Claim 1[b][i]-[iii], Kaiser in view of Bauch renders obvious 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 samples from the guard interval portion of the first OFDM packet are shifted out of the guard interval portion of the shifted version.

A POSITA would understand that a second transmit processor performs such processing functions because there must have been, or at least obviously

would have been, a processor to generate the shifted signal as taught by Kaiser. *See* EX1003 ¶177. And that second processor is a second transmit processor because it processes the signal for transmission. *See id.* Bauch confirms that the system contains a second transmit processor to process the signal as taught by Kaiser and Bauch. *See* EX1007 at, e.g., 4:21-22 (discussing “**processing** ... the transmit signal”).

The “first transmit processor” is the code that generates the first OFDM packet in accordance with Claim 8[a], while the “second transmit processor” is the code that generates the shifted version of the first OFDM packet in accordance with Claim 8[b]. These obviously would have been different code modules, for at least two reasons. **First**, both Kaiser’s Figure 4 and Bauch’s Figure 4 illustrate the cyclic shift as being applied on a separate path connected to separate antennas relative to the first (unshifted) OFDM packet, and therefore a POSITA would have understood both Kaiser and Bauch to be teaching two separate transmit processor modules:



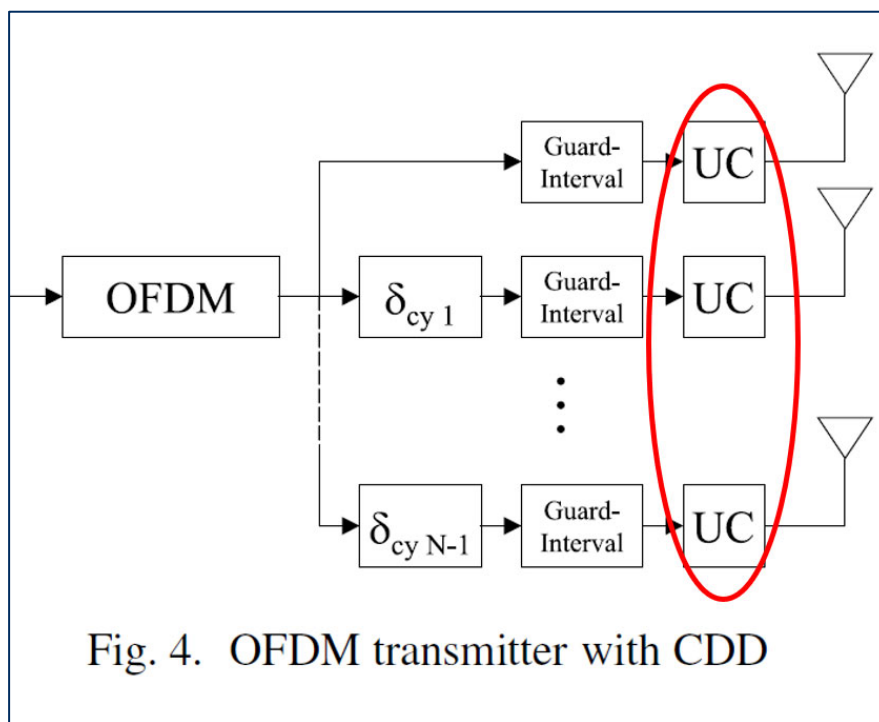
See EX1007 at Fig. 4 (cropped); EX1006 at Fig. 4 (cropped); EX1003 ¶178. And **second**, as a POSITA would recognize, different code modules could be processed in parallel and thus more quickly. See EX1003 ¶178. Having different code modules for the transmit processors would therefore improve the system, reducing system bottlenecks.

As noted above, the '439 Patent does not require that the claimed “first transmit processor” and “second transmit processor” be two physically separate processor devices. See Ground I, Claim 8[b]. But if this limitation is construed to require physically distinct transmit processors, Kaiser in view of Bauch renders this obvious. As shown above in both Kaiser’s and Bauch’s Figure 4, the shifted OFDM packet is generated separately on a different transmit path to a different physical antenna, apart from the first (non-shifted) OFDM packet that is provided to another antenna. Thus, a POSITA would have understood, or at least found

obvious, that Kaiser and Bauch were both suggesting the use of physically separate transmit processors associated with physically separate antennas. *See id.*; EX1003 ¶179 A POSITA would have been motivated to try this approach, known that this was common in the art, and had a reasonable expectation of success for the same reasons discussed above in Ground I, Claim 8[b]. *See* EX1003 ¶179; § VII.A.8.c.

d. Limitation 8[c]

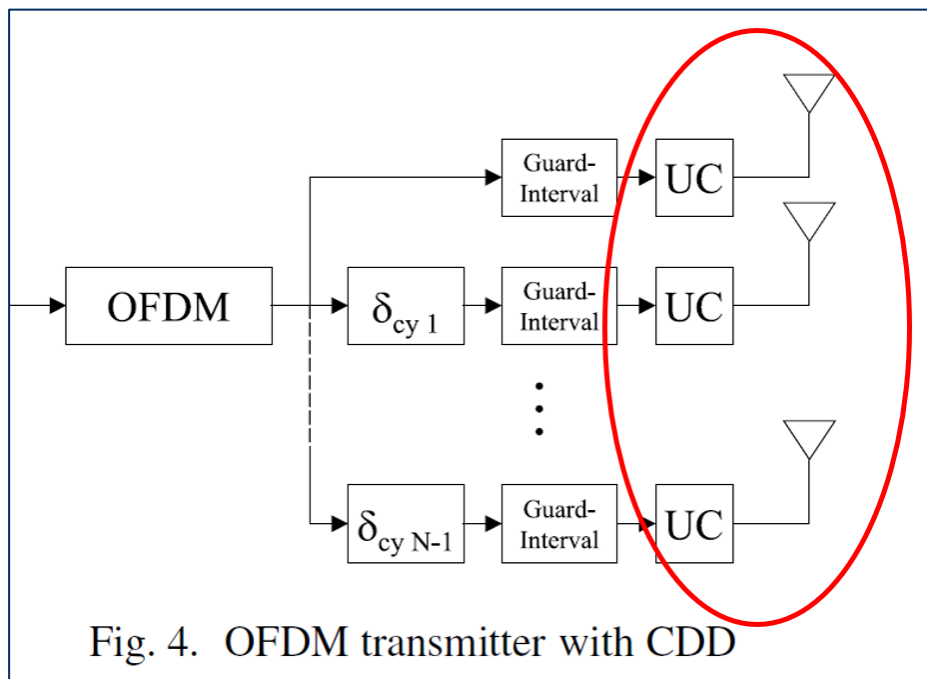
Kaiser teaches this limitation. *See* EX1003 ¶180. Kaiser’s Figure 4 depicts a plurality of radio transmitters that perform the function of “UC” blocks, about which Kaiser teaches: “The functional block ‘UC’ again does upconversion of the signals from the baseband into RF-band”:



See EX1006 at 2, Fig. 4 (annotated). A POSITA would understand that “RF-band” refers to “radio signals.” See EX1003 ¶180. Thus, as a POSITA would expect, Kaiser converts the first OFDM packet and the shifted version of the OFDM packet from data in the baseband to corresponding radio signals, and that conversion is performed by Kaiser’s radio transmitters corresponding to the “UC” blocks. See *id.*

e. Limitation 8[d]

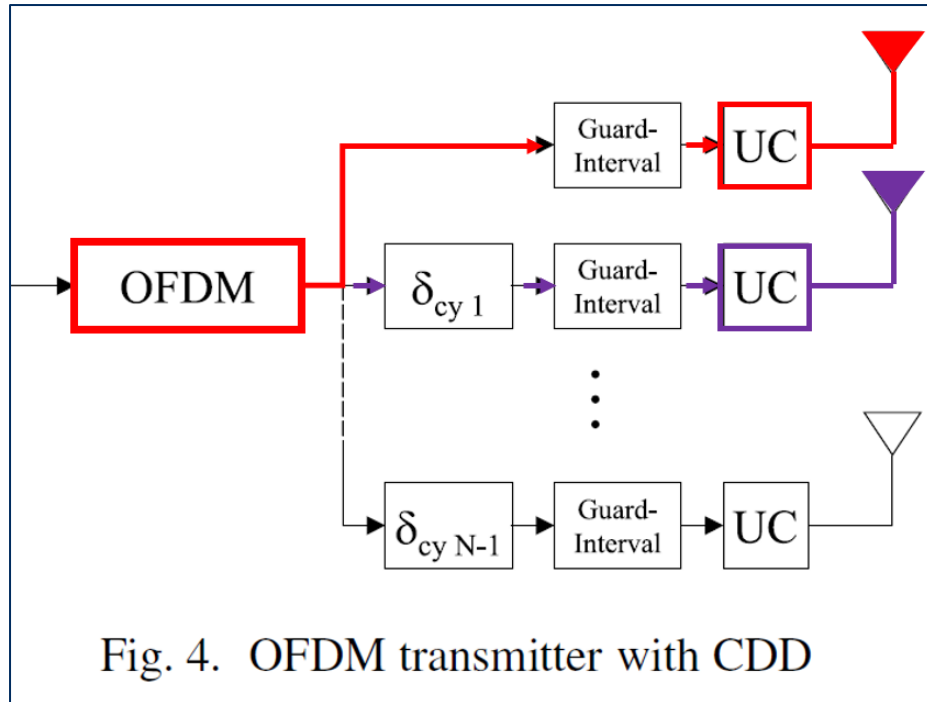
Kaiser teaches this limitation. See EX1003 ¶181. For example, Kaiser’s Figure 4 teaches a plurality of radio antennas (downward-pointing triangle) that are coupled (direct line connection) to the plurality of radio transmitters (that perform the “UC” block function as discussed in the prior limitation, among others):



See EX1006 at 2, Fig. 4 (annotated). Kaiser teaches that the plurality of radio antennas are for transmitting the radio signals, as expected given their function and the purpose of the system. See *id.* (“The OFDM modulated signal is transmitted over N antennas, whereas the particular signals only differ in an antenna specific cyclic shift.”).

f. Limitation 8[e]

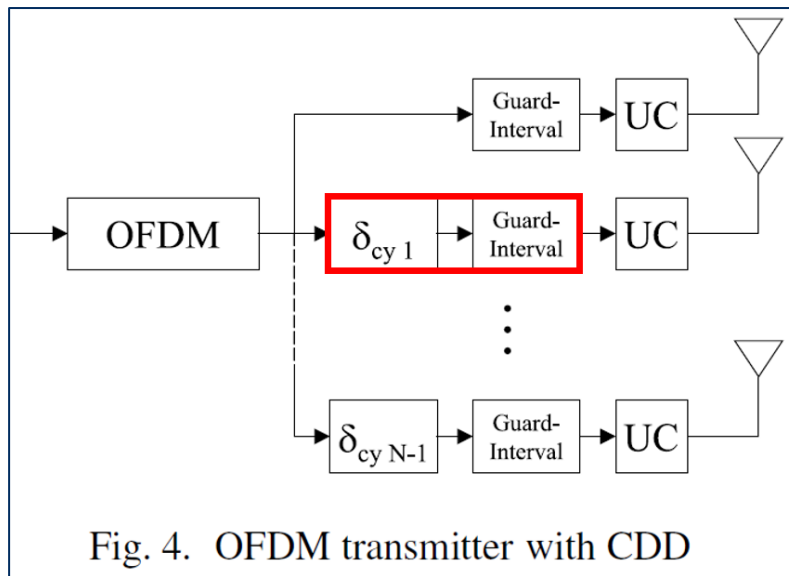
Kaiser teaches this limitation. See EX1003 ¶182. As discussed (incorporated herein) in Claim 1[c], Kaiser teaches substantially simultaneously transmitting the first OFDM packet and the shifted version of the OFDM packet. See § VII.A.1.g. The system components that are configured to substantially simultaneously cause that transmission are the first transmit processor and the second transmit processor, since those are the processors that generate the first (unshifted) OFDM packet and the shifted version of the OFDM packet, as discussed in Claim 8[a]-[b]. And these packets are transmitted via corresponding transmitters and antennas, as illustrated in t Kaiser’s Figure 4, showing the first (unshifted) OFDM packet transmitted via the corresponding **transmitter** (“UC” block) and **antenna** in **red**, while the shifted version of the OFDM packet is transmitted via the corresponding **transmitter** and **antenna** in **purple**:



See EX1006 at Fig. 4 (annotated); EX1003 ¶182.

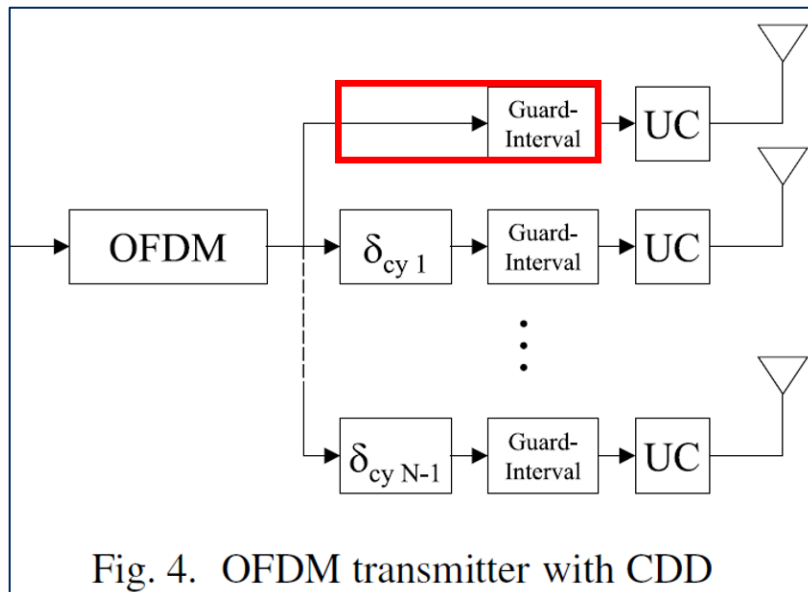
9. Claim 9

Kaiser in view of Bauch and IEEE renders this claim obvious. As noted above, Kaiser's cyclic extensions are guard intervals. See EX1006 at 2. The cyclic extension module for performing cyclical shifts is within the second transmit processor depicted in Kaiser's Figure 4:

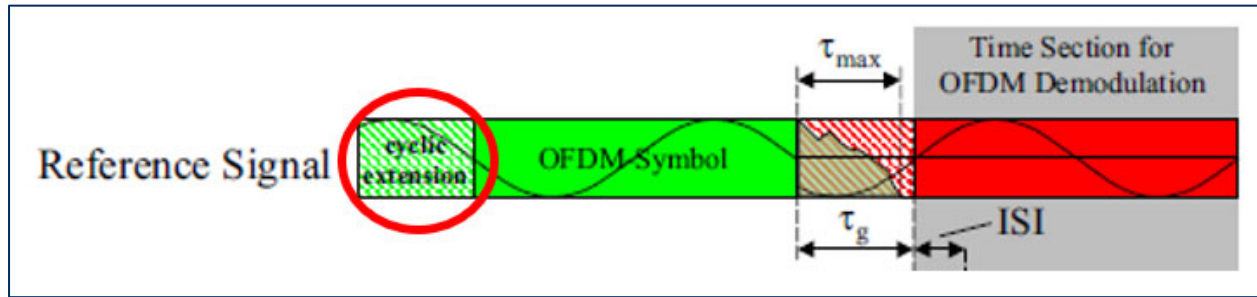


See EX1006 at Fig. 4 (annotated); EX1003 ¶¶183-84. Applying Bauch’s cyclical advancement teaching to Kaiser here means that the cyclic extension module in the second transmit processor would also be for performing cyclical advancement. See Claim 8[b].

The cyclic extension module for performing cyclic shifts associated with the first transmit processor is not expressly illustrated in Kaiser’s Figure 4:



See EX1006 at Fig. 4 (annotated); EX1003 ¶184 However, the first transmit processor does have a cyclic extension module, as Kaiser illustrates that even the Reference Signal (the first, unshifted OFDM packet) has a cyclic extension:



See EX1006 at Fig. 3 (cropped, annotated). And although its application for cyclic shifting is not illustrated, it would at least obviously have had such ability. As a POSITA would have recognized, systems were not designed with one single dedicated antenna for the unshifted reference signals because doing so would hamper the system's flexibility. See EX1003 ¶184. Thus, as a POSITA would have known, every pathway in the antenna system would generally have been, and would obviously have been, equipped with the ability to cyclically shift. See *id.* (discussing EX1012 at Fig. 8A, which shows a module for performing a "Circular Shift by 0 Sample"). Moreover, as the '439 Examiner recognized, a POSITA would also have found it obvious to have the cyclic shift ability on each antenna path. See EX1002 at 1051. And, as with the cyclic extension module in the second transmit processor, the cyclic extension module in the first transmit processor

would have been for performing cyclical advancements once Bauch's teachings are applied. *See* Claim 8[b].

10. Claim 10

Kaiser in view of Bauch and IEEE renders this claim obvious. As discussed (incorporated herein) in Claim 3, Kaiser in view of Bauch renders obvious cyclically advancing the OFDM packet for a duration of less than one half of the sample duration of the guard interval. This Claim 10 is the system counterpart to method Claim 3, and it is the cyclic extension modules identified in Claim 9 that perform the method steps claimed in Claim 3.

Bauch teaches cyclically shifting by one coefficient (corresponding to one sample), which is less than one half of the sample duration of the IEEE-compliant guard interval (16 samples), further confirming that a POSITA would have configured each of the cyclic extension modules to cyclically advance the OFDM packet for a duration of less than one half of sample duration of the guard interval. *See* EX1007 at 22:25-27; EX1003 ¶¶185-86.

11. Claim 11

Kaiser in view of Bauch and IEEE renders this claim obvious. As discussed in Claim 2, Kaiser in view of Bauch and IEEE would be configured to cyclically advance the OFDM packet for a duration of less than approximately 800 nanoseconds, as taught by IEEE in order to comply with the standard and Bauch's

teaching. Each of the cyclic extension modules in the system of Kaiser in view of Bauch and IEEE would obviously have been so configured because each would comply with the standard; it makes no sense to have some cyclic extension modules comply with the standard while others do not. *See* EX1003 ¶187. And, as discussed above in the context of Claim 9, each of the cyclic extension modules would be configured to cyclically advance. *See* EX1003 ¶¶184, 187 (discussing, for example, EX1012 at Fig. 8A, which shows a module for performing a “Circular Shift by 0 Sample”); EX1002 at 1051.

12. Claim 12

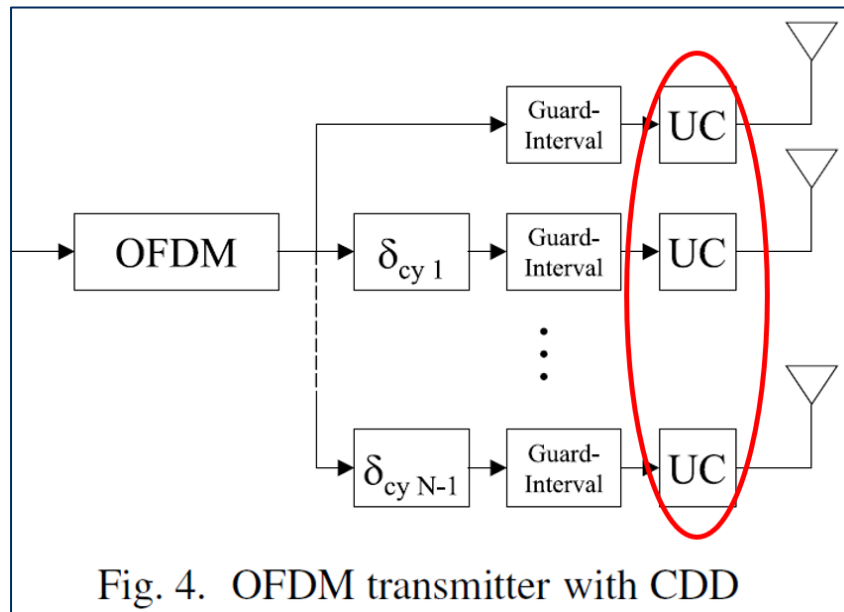
Kaiser in view of Bauch and IEEE renders this claim obvious. Kaiser teaches that “it is necessary for wireless communications systems to use ... interleaving.” *See* EX1006 at 1. As expected, Kaiser teaches a module that receives data and interleaves the received data. *See id.* at 4, Fig. 9. The data is interleaved into a plurality of sub-carrier channels. *See id.* at, e.g., 5 (“The number of used carriers is $K = 1705$. This yields a *subcarrier* spacing ...”). IEEE confirms that this was part of the standard. *See* EX1008 at 29 (“*All* encoded data bits *shall* be interleaved....”). Therefore, the claimed interleaving would have been expected by and obvious to a POSITA because Kaiser’s system performed such interleaving and would have complied with the IEEE standard. *See* EX1003 ¶¶188-89.

13. Claim 13

Kaiser in view of Bauch and IEEE renders this claim obvious. Kaiser's Figure 9 shows a series of data processing, such as coding and interleaving, followed by an "OFDM" functional block. *See* EX1006 at Fig. 9. Bauch teaches that, after this pre-processing, "OFDM is then implemented" by performing "the inverse fast Fourier transform (IFFT)..." *See* EX1007 at 23:8-10. A POSITA would thus understand, or at least find obvious, that the way Kaiser creates the OFDM symbols from the incoming data represented by those pre-processing blocks is through a code module that performs IFFT functions because that is how Bauch teaches the OFDM symbols are created and that is how a POSITA would have been accustomed to doing so. *See id.*; EX1003 ¶¶190-91. IEEE confirms that IFFT was the "common way to implement" this process, and thus would have, or at least obviously would have, been performed by Kaiser's system. *See* EX1008 at 23; EX1003 ¶¶124, 190-91 (discussing EX1008 at 20, teaching that "***each*** group of subcarriers" get converted "to time domain using inverse Fourier transform"). And each of the transmit processors would obviously have included such an IFFT module for generating OFDM symbols from the incoming data because otherwise they could not have transmitted OFDM signals. *See* EX1006 at 2; EX1003 ¶191.

14. Claim 14

Kaiser in view of Bauch and IEEE renders this claim obvious. As shown in Kaiser, the “UC” blocks that perform “upconversion of the signals from the baseband into RF-band” are positioned *after* the cyclic shift blocks:



See EX1006 at 2, Fig. 4 (annotated). Thus, as a POSITA would recognize, the first and second transmit processors perform their cyclic shifts (here, a cyclic advancement) on baseband signals because the signal has not yet been upconverted. See EX1003 ¶¶192-94; see also Ground I, Claim 14. IEEE also confirms that this is how the process was supposed to proceed. See EX1008 at 20 (step (n) upconversion from baseband occurs after steps (l)-(m) cyclic diversity application); EX1003 ¶194.

15. Claim 15

Kaiser in view of Bauch and IEEE renders this claim obvious. Kaiser's transmit processors must be implemented on a physical processor, and an ASIC was an obvious choice for the same reasons as discussed in Claim 15 in Ground I. *See* EX1003 ¶195.

16. Claim 16

Kaiser in view of Bauch and IEEE renders this claim obvious. As discussed in Claim 2, Kaiser expressly teaches that its system is compliant with the IEEE 802.11 standard. *See* EX1006 at, *e.g.*, Abstract, 1, 6. Applying Bauch's techniques to Kaiser's system would not change the transmitter's compliance with the IEEE 802.11 standard. As the '439 Patent recognizes, a small advance versus a large delay is "identical ... from the perspective of the" receiver or transmitter, so there is no impact in applying Bauch's technique to Kaiser. *See* EX1001 at 8:5-18 ("[T]ransmitter device 602 (FIG. 6) transmits the identical signal in each case."); EX1003 ¶196.

17. Claim 17

Kaiser in view of Bauch and IEEE renders this claim obvious. Kaiser's transmit processors must be implemented on a physical processor, and an FPGA was an obvious choice for the same reasons as discussed in Claim 17 in Ground I. *See* EX1003 ¶197.

18. Claim 18

Kaiser in view of Bauch and IEEE renders this claim obvious. Kaiser's transmit processors must be implemented on a physical processor, and firmware stored in a memory device and executed by a suitable instruction execution system was an obvious choice for the same reasons as discussed in Claim 18 in Ground I. *See* EX1003 ¶198.

19. Claim 19

Kaiser in view of Bauch and IEEE renders this claim obvious.

a. 19[preamble]

Kaiser teaches the preamble. *See* Claim 8[preamble]; EX1003 ¶200.

b. 19[a]

Kaiser in view of Bauch and IEEE renders this limitation obvious. *See* EX1003 ¶201. By reference to Claim 8[a], the algorithm by which the transmit processor for generating a first OFDM packet would generate that packet is the algorithm disclosed in the IEEE 802.11 standard because Kaiser's system is expressly intended to, and complies with, IEEE 802.11. *See* Claim 16; EX1003 ¶201.

c. 19[b]

Kaiser in view of Bauch and IEEE renders this limitation obvious. *See* Claim 8[b]; EX1003 ¶202.

d. 19[c]

Kaiser in view of Bauch and IEEE renders this limitation obvious. *See* EX1003 ¶203. Referencing Claim 8[c], the algorithm by which the radio transmitters would convert those packets is the algorithm disclosed in the IEEE 802.11 standard because Kaiser's system is expressly intended to, and complies with, IEEE 802.11. *See* Claim 16; EX1003 ¶203.

e. 19[d]

Kaiser in view of Bauch and IEEE renders this limitation obvious. *See* EX1003 ¶204. Referencing Claim 8[e], the algorithm by which the transmit processors would cause substantially simultaneous transmission is the algorithm disclosed in the IEEE 802.11 standard because Kaiser's system is expressly intended to, and complies with, IEEE 802.11. *See* Claim 16; EX1003 ¶204.

20. Claim 20

Kaiser in view of Bauch and IEEE renders this claim obvious. *See* Claims 3, 10. As discussed (incorporated herein) in Claim 3, both the admitted prior art and Kaiser in view of Bauch and IEEE renders obvious a cyclic advance with a duration less than one of half of [sic] sample duration of the guard interval of the OFDM packet because Bauch teaches a one sample shift, and a standard guard interval is 16-samples. *See* EX1007 at 22:25-23:1; EX1003 ¶205.

21. Claim 21

Kaiser in view of Bauch and IEEE renders this claim obvious. *See* Claim 4. As discussed (incorporated herein) in Claim 4, Kaiser in view of Bauch and IEEE renders obvious a legacy receiver because as a POSITA would have been aware and the '439 Patent admits, “there is a need to consider legacy receivers (e.g., single-input, single output (SISO), OFDM receivers),” because not all network participants upgrade their equipment at the same time; accordingly, a POSITA would have obviously accounted for those using legacy receivers. *See* EX1001 at 1:27-29; Ex.1003 ¶¶206-07.

Cyclical advancements, as delays, cause the legacy receiver to produce a plurality of impulse responses in an acquisition process, and each of the first OFDM packet and the shifted version of the OFDM packet would correspond to one of the plurality of impulse responses because the impulse response “is indistinguishable from ... linear delay diversity” (a plurality of responses in time). *See* EX1001 at 4:5-22; EX1003 ¶¶206–07.

VIII. NO SECONDARY CONSIDERATIONS

There are no secondary considerations of non-obviousness with a nexus to the claimed invention of the '439 Patent. *See* EX1003 ¶¶208-17.

Patent Owner may contend that there is evidence of unexpected results in Figure 9 of the '439 Patent itself, but the patent's description of that figure is

misleading. As noted above, the '439 Patent first teaches that, “mathematically, a small cyclic advance ... is identical or equivalent to a [correspondingly] large delay,” (EX1001 at 8:5-9), but later in the specification, the '439 Patent asserts: “Experimental testing has shown that legacy radios show significant performance gains in packet error rate with small advancements (e.g., 100 nsec) as opposed to large delays (e.g., that span an almost an entire FFT).” *See id.* at 8:24-27. These “performance gains” would indeed be unexpected given the patent’s prior admission that the two are mathematically identical, but the purported evidence cited by the patent (Figure 9) does not actually indicate any performance gains.

Figure 9 of the '439 Patent “is a plot that illustrates packet error performance of cyclic advance diversity compared to cyclic delay diversity.” *See id.* at 8:27-29. Figure 9 purports to show that at a given power level, the packet failure rate is lower with cyclic advance than with cyclic delay. *See id.* at Fig. 9, 8:29-34. Critically, however, Figure 9 is **not** an apples-to-apples comparison of advances and delays. The dashed lines in Figure 9 correspond to small cyclic delays of 1 and 2 samples¹², while the solid lines correspond to slightly larger cyclic advances of 2, 3, and 4 samples. *See id.* at 8:34-40. But what is “identical or equivalent” are small

¹² The dashed line associated with 0 is the reference signal with no shift in either direction. *See* EX1001 at 8:40-42.

cyclic advances with their correspondingly large cyclic delays, which is the opposite of what is shown in Figure 9. *See id.* at 8:5-9. Figure 9 therefore does not illustrate “[e]xperimental testing [of] ***small advancements*** (e.g., 100 nsec) as opposed to ***large delays***,” rather it compares ***small delays*** and ***small-but-slightly larger advancements***. *See id.* at 8:24-26. Had the testing been an apples-to-apples comparison of small advancements with correspondingly large delays, a POSITA would have instead found “identical or equivalent” results, because, as the ’439 Patent admits, they are mathematically equivalent. *See id.* at 8:5-9; EX1003 ¶¶212-14. Thus, Figure 9 does not evidence any unexpected “performance gains” as the ’439 Patent asserts.

The patent’s self-serving, hearsay statement of “significant performance gains” is unsupported and unreliable, and therefore it should be afforded no weight. *See In re Cree, Inc.*, 818 F.3d 694, 702 (Fed. Cir. 2016). But to the extent the Board does afford it any weight, it would still be insufficient to overcome Larsson’s and Bauch’s unambiguous teachings of cyclic advances that, in combination with the other references, render the Challenged Claims invalid. *See Wyers v. Master Lock Co.*, 616 F.3d 1231, 1246 (Fed. Cir. 2010) (Secondary considerations “simply cannot overcome a strong prima facie case of obviousness.”).

IX. NO DISCRETIONARY DENIAL

A. The Board Should Not Decline Institution Based On *Fintiv*

The Board should not exercise its discretion under § 314(a) to deny institution in view of the Texas Litigation (*see* Mandatory Notices, *infra*) because the balance of the *Fintiv* factors discussed below weigh in favor of institution.

Fintiv Factor 1 (likelihood of a stay) is neutral. There are two patents at issue in the Texas Litigation (the '439 Patent and U.S. Patent No. 7,089,443). Petitioners will be challenging (more than) all asserted claims of both patents in IPR. Institution of the two IPR petitions would thus enable the Board to resolve core issues in, if not completely moot, the Texas Litigation. As such, the District Court likely would stay the case pending the outcome of the IPRs in view of the potentially substantial judicial efficiencies to be gained. Indeed, Judge Albright (who is presiding over the Texas Litigation) routinely stays cases after IPR is instituted for this reason. *See, e.g., Pedersen v. Oracle Corp.*, Case No. 6:22-cv-00410-ADA, Dkt. 42 at 6 (W.D. Tex. Aug. 24, 2023); *Lone Star SCM Sys., Ltd. v. Zebra Techs. Corp.*, Case No. 6:21-cv-00842-ADA, Dkt. 85 at 6-8 (W.D. Tex. July 31, 2023). Thus, this factor is neutral.

Factor 2 (proximity of trial date to IPR deadline) weighs slightly in favor of denial. The District Court tentatively set trial in the Texas Litigation for July 28, 2025, but “scheduled trial dates are unreliable and often change” so “[a] court’s

schedule trial date, therefore, is not by itself a good indicator of whether the district court trial will occur before the statutory deadline for a final written decision.” *See* Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation (June 21, 2022) (“Vidal Memo”) at 8.

Factor 3 (investment in parallel proceeding) weighs against discretionary denial. The Texas Litigation is in its early stages. The parties have only exchanged preliminary infringement and invalidity contentions and associated document productions. But fact discovery only opens on July 30, 2024. The parties and the District Court have therefore invested relatively minimal resources to date, such that this factor weighs against discretionary denial.

Factor 4 (overlap between issues) weighs against discretionary denial. Petitioners stipulate that, if IPR is instituted, Petitioners will not pursue in the Texas Litigation the same grounds asserted in this Petition. This “mitigates to some degree the concerns of duplicative efforts.” *See Sand Revolution II, LLC v. Continental Intermodal Group—Trucking LLC*, IPR2019-01393, Paper 24 at 12 (P.T.A.B. June 16, 2020). Moreover, this Petition challenges unasserted Claims 4-6, 12, 17, and 19-21, such that their validity will not be addressed at all in that proceeding (nor in the other IPR petition pending against the ’439 Patent filed by Zebra, discussed below). This factor thus weighs against discretionary denial.

Factor 5 (same parties) weighs slightly in favor of denial because Petitioners and Patent Owner are the same parties in both this proceeding and in the Texas Litigation (as is common in most IPR proceedings).

Factor 6 (other circumstances impacting discretion) weighs against discretionary denial. As discussed above, the key references disclose the sole alleged distinction between the admitted prior art and the claimed invention (cyclic advancement versus cyclic delay). *See* EX1001 at 5:37-41. The asserted prior art thus heavily weighs against denial because the merits are so clear.

Overall, one factor is neutral, three factors weigh against discretionary denial, and two factors weigh slightly in favor of discretionary denial. On balance, therefore, the *Fintiv* factors weigh against denial.

B. The Board Should Not Decline Institution Based On *General Plastic*

As discussed below, every *General Plastic* factor either weighs against the Board's exercise of discretion to deny institution or is neutral.

Factor 1 (multiple petitions by the same petitioner) weighs against discretionary denial. The '439 Patent is the subject of one other IPR (IPR2024-00883), but that IPR was filed by a separate, unaffiliated company called Zebra Technologies Corporation ("Zebra"), who is not a co-defendant with Petitioners in the Texas Litigation. *See* EX1010. There is no common corporate relationship between the Petitioners here and Zebra. *See* IPR2024-00883, Paper 21 at 1 (Zebra

not representing any relationship with Petitioners). This factor therefore weighs against denial.

Factors 2, 4, and 5 (diligence) are all irrelevant and thus neutral because Petitioners in this proceeding have not filed another IPR against the '439 Patent.

Factor 3 (roadmap) weighs against discretionary denial. Petitioners could not have “tailor[ed] [their] arguments to address issues identified by” the Patent Owner or Board during Zebra’s IPR proceeding because Patent Owner has not yet filed its POPR in that proceeding.

Factors 6 and 7 (finite resources and time constraints) weigh against discretionary denial. There is only one other IPR petition challenging the '439 Patent. Moreover, that one other IPR has not been instituted, such that there may ultimately be only one instituted IPR related to the '439 Patent. There also are only two grounds in this Petition, and they are both straightforward, further reducing the burden on the Board’s finite resources. And the claims of the '439 Patent are bucketed into substantially corresponding sets of method, system, and means-plus-function claims. Overall, therefore, this Petition is highly streamlined and requires the Board to analyze a relatively small number of claims, prior art references, and grounds, such that the additional burden on the Board is not unreasonable, and these factors weigh against discretionary denial.

In sum, Factors 1, 3, 6, and 7 all weigh against discretionary denial, while Factors 2, 4, and 5 are irrelevant and therefore neutral. On balance, the *General Plastic* Factors weigh against discretionary denial.

C. The Board Should Not Decline Institution Pursuant To § 325(d)

The Board should not deny this Petition under § 325(d) because both prongs of the *Advanced Bionics* framework are satisfied.

1. The Petition Includes New Prior Art And A New Ground

Ground II relies on two references—Kaiser and Bauch—that were never before the Examiner. *See generally* EX1002. And although IEEE was before the Examiner, IEEE was not combined with Kaiser and Bauch, so Ground II is still fundamentally a new ground. *See Kea Cloud, Inc. & Hi Auto, Inc. v. Valvant AI, Inc.*, IPR2023-00450, Paper 12, at 12–13 (P.T.A.B. July 19, 2023).

2. The Examiner Overlooked Material Teachings In The Previously Considered Prior Art

Ground I relies on Larsson, a portion of which was substantively discussed during prosecution, but as noted above in Section VI.A, the Examiner overlooked and never discussed the key teaching in Larsson (EX1005 at 9:41–47) that is material to patentability and relied upon herein. This disclosure that the Examiner overlooked is also material to patentability for the reasons explained above in Ground I. Therefore, the Board should not exercise its discretion to deny institution under § 325(d).

X. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8(A)(1)

A. 37 C.F.R. § 42.8(b)(1): Real Party-in-Interest

TCL Electronics Holdings Ltd. and TCL Industries Holdings Co., Ltd. (collectively, “Petitioners”) are the real parties-in-interest.

B. 37 C.F.R. § 42.8(b)(2): Related Matters

The ’439 Patent is one of two patents¹³ asserted in *Intellectual Ventures I LLC v. TCL Electronics Holdings Ltd.*, Case No. 6:23-cv-00309-ADA (W.D. Tex.) (the “Texas Litigation”). The ’439 Patent also was at issue in Case No. 6:23-cv-00293 (W.D. Tex.), but the complaint in that case was never served; rather, that case was voluntarily dismissed shortly after filing and then a new action was filed the same day, which became the -00309 Texas Litigation referenced above.

The ’439 Patent is the subject of one other IPR petition, IPR2024-00883, that was filed by a third party called Zebra Technologies Corporation, which presents grounds based on different prior art.

The ’439 Patent is asserted in the following District Court litigations, none of which involve Petitioners:

- *Intellectual Ventures I LLC v. Lenovo Grp. Ltd.*, Case No. 6:23-cv-00307 (W.D. Tex.)

¹³ The other patent asserted in the Texas Litigation, U.S. Patent No. 7,089,443, does not have any family relationship to the ’439 Patent.

Petition for *Inter Partes* Review of U.S. Patent No. 7,623,439

- *Intellectual Ventures I LLC v. Zebra Techs. Corp.*, Case No. 6:23-cv-00292 (W.D. Tex.)

The '439 Patent also was asserted in the following now-dismissed District Court litigations, none of which involved Petitioners:

- *Intellectual Ventures I LLC v. TP-Link Corp.*, Case No. 6:23-cv-00308 (W.D. Tex.)
- *Intellectual Ventures I LLC v. TP-Link Corp.*, Case No. 6:23-cv-00291 (W.D. Tex.)
- *Intellectual Ventures I LLC v. OnePlus Tech. (Shenzen) Co.*, Case No. 6:23-cv-00290 (W.D. Tex.)
- *Intellectual Ventures I LLC v. Lenovo Grp. Ltd.*, Case No. 6:23-cv-00068 (W.D. Tex.)
- *Intellectual Ventures I LLC v. Hewlett Packard Enterprise Co.*, Case No. 1:22-cv-01350 (D. Del.)

The present proceeding may affect, or be affected by, any of the above litigations or IPR proceedings.

C. 37 C.F.R. § 42.8(b)(3) And (4): Counsel And Service Information

Lead Counsel	Back-Up Counsel
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Petitioners concurrently submit a Power of Attorney, 37 C.F.R. § 42.10(b), and consent to electronic service directed to the following email address: TCL-IV-IPR@kirkland.com.

XI. PAYMENT

The undersigned authorizes the Office to charge the fee set forth in 37 C.F.R. § 42.15(a)(1) for this Petition and any additional fees in connection with this Petition to Deposit Account No. 506092. Review of 21 claims is requested.

XII. CERTIFICATION

Petitioners certify that the '439 Patent is available for IPR and that Petitioners are not barred or estopped from requesting an IPR of the Challenged Claims on the grounds identified herein.

Petition for *Inter Partes* Review of U.S. Patent No. 7,623,439

Dated: July 31, 2024

Respectfully submitted,

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Attorneys for Petitioners

APPENDIX OF CHALLENGED CLAIMS

Claim Limitation	Claim Language
1[preamble]	A method for transmitting orthogonal frequency division multiplexing (OFDM) signals comprising:
1[a][i]	generating a first OFDM packet for transmission
1[a][ii]	including a guard interval portion and a symbol data portion each comprised of a plurality of samples
1[b][i]	cyclically advancing the first OFDM packet by shifting the samples in a first direction
1[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
1[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
1[c]	substantially simultaneously transmitting the first OFDM packet and the shifted version of the OFDM packet.
2	The method of claim 1, further comprising cyclically advancing the OFDM packet for a duration of less than approximately 800 nanoseconds.
3	The method of claim 1, further comprising cyclically advancing the OFDM packet for a duration of less than one half of the sample duration of the guard interval portion.
4	The method of claim 1, further comprising a legacy receiver, and wherein the cyclical advancements of the shifted version of the OFDM packet cause the legacy receiver to produce a plurality of impulse responses in an acquisition process, and wherein each of the first OFDM packet and the shifted version of the OFDM packet corresponds to one of the plurality of impulse responses.
5	The method of claim 4, wherein an impulse response corresponding to the shifted version of the OFDM packet occurs earlier in time than an impulse response corresponding to the first OFDM packet.
6	The method of claim 4, wherein the legacy OFDM receiver is a single-input, single-output (SISO) receiver device.

Claim Limitation	Claim Language
7	The method of claim 1, further comprising transmitting the first OFDM packet and the shifted version of the OFDM packet from a multiple-antenna transmitter device.
8[preamble]	A signal transmitting system for transmitting orthogonal frequency division multiplexing (OFDM) signals comprising:
8[a]	a first transmit processor 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;
8[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 samples from the guard interval portion of the first OFDM packet are shifted out of the guard interval portion of the shifted version;
8[c]	a plurality of radio transmitters for converting the OFDM packet and the shifted version of the OFDM packet to corresponding radio signals;
8[d]	and a plurality of radio antennas correspondingly coupled to the plurality of radio transmitters for transmitting the radio signals;
8[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.
9	The system of claim 8, wherein each of the first and second transmit processors includes a cyclic extension module for performing cyclical advancements.
10	The system of claim 9, wherein each of the cyclic extension modules is configured to cyclically advance the OFDM packet for a duration of less than one half of sample duration of the guard interval.
11	The system of claim 9, wherein each of the cyclic extension modules is configured to cyclically advance the OFDM packet for a duration of less than approximately 800 nanoseconds.

Claim Limitation	Claim Language
12	The system of claim 8, wherein the first transmit processor is configured to receive incoming data and interleave the received data into a plurality of sub-carrier channels.
13	The system of claim 8, wherein each of the plurality of transmit processors further includes an Inverse Fast Fourier (IFFT) module for generating OFDM symbols from incoming data.
14	The system of claim 8, wherein the first and second transmit processors perform the cyclical advancements on baseband signals.
15	The system of claim 8, wherein the first and second transmit processors include application specific integrated circuits (ASICs).
16	The system of claim 8, wherein the transmitter is an 802.11 compliant device.
17	The system of claim 8, wherein the first and second transmit processors include field programmable gate arrays (FPGAs).
18	The system of claim 8, wherein the first and second transmit processors include firmware stored in a memory device and executed by a suitable instruction execution system.
19[preamble]	A signal transmitting system for transmitting orthogonal frequency division multiplexing (OFDM) signals comprising:
19[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;
19[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;
19[c]	means for convening the first OFDM packet and the shifted version of the OFDM packet to corresponding radio signals; and

Claim Limitation	Claim Language
19[d]	means for substantially simultaneously causing the transmission of the first OFDM packet and the shifted version of the OFDM packet.
20	The system of claim 19, wherein the cyclic advance has a duration less than one of half of sample duration of the guard interval of the OFDM packet.
21	The system of claim 19, further comprising a legacy receiver, and wherein the cyclical advancements of the shifted version of the OFDM packet cause the legacy receiver to produce a plurality of impulse responses in an acquisition process, and wherein each of the first OFDM packet and the shifted version of the OFDM packet corresponds to one of the pluralities of impulse responses.

CERTIFICATION OF COMPLIANCE

The undersigned certifies that the foregoing Petition complies with the type-volume limitations as mandated in 37 C.F.R. § 42.24, totaling 13,985 words. Counsel has relied upon the word count feature provided by Microsoft Word. This word count does not include the items excluded by 37 C.F.R. § 42.24 as not counting towards the word limit.

Dated: July 31, 2024

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CERTIFICATE OF SERVICE ON PATENT OWNER

Pursuant to 37 C.F.R. §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that a copy of the foregoing document with accompanying Exhibits 1001-1015, as listed in Petitioner's Exhibit List on page ix of this document, was caused to be served by Federal Express, costs prepaid, to Patent Owner at the following address of record:

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Dated: July 31, 2024

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