

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD. AND SAMSUNG ELECTRONICS
AMERICA, INC.,
Petitioner,

v.

GENGHISCOMM HOLDINGS LLC,
Patent Owner

Case: IPR2025-00789
U.S. Patent No. 11,075,786

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 11,075,786**

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LISTING OF CLAIMS

Claim 1. [1Pre] A method of communication in a wireless communication network that employs a first set of complex-valued codes to encode data symbols to be transmitted, and employs a second set of complex-valued codes to recover transmitted data symbols from a received signal, the method comprising:

[1A] selecting a plurality of subcarriers to be transmitted;

[1B] encoding the data symbols with the first set of complex-valued codes to produce encoded data symbols;

[1C] applying the encoded data symbols to the plurality of subcarriers to produce a spread-Orthogonal Frequency Division Multiplexing (OFDM) signal; and

[1D] transmitting the spread-OFDM signal;

[1E] wherein the first set of complex-valued codes are complex conjugates of the second set of complex-valued codes.

Claim 2. The method of claim 1, wherein selecting is responsive to spectrum allocation or is configured to provide for orthogonal frequency division multiple access.

Claim 6. The method of claim 1, wherein the plurality of subcarriers are contiguous subcarriers or interleaved subcarriers.

Claim 7. The method of claim 1, wherein encoding comprises multiplying a vector

or matrix of data symbols with a vector or matrix comprising the first set of complex-valued codes.

Claim 8. The method of claim 1, wherein applying comprises modulating the encoded data symbols onto the plurality of subcarriers.

Claim 9. The method of claim 1, further comprising adding a cyclic prefix to the spread-OFDM signal before transmitting the spread-OFDM signal.

Claim 10. [10Pre] An apparatus for communication in a wireless communication network that employs a first set of complex-valued codes to encode data symbols to be transmitted, and employs a second set of complex-valued codes to recover transmitted data symbols from a received signal, the apparatus comprising:

[10A] at least one processor; and

[10B] a non-transitory computer-readable memory communicatively coupled to the at least one processor, the non-transitory computer-readable memory including a set of instructions stored thereon and executable by the at least one processor for:

[10Ci] selecting a plurality of subcarriers to be transmitted;

[10Cii] encoding the data symbols with the first set of complex-valued codes to produce encoded data symbols;

[10Ciii] applying the encoded data symbols to the plurality of subcarriers to produce a spread-Orthogonal Frequency Division Multiplexing (OFDM) signal; and

[10Civ] transmitting the spread-OFDM signal;

[10Cv] wherein the first set of complex-valued codes are complex conjugates of the second set of complex-valued codes.

Claim 11. The apparatus of claim 10, wherein selecting is responsive to spectrum allocation or is configured to provide for orthogonal frequency division multiple access.

Claim 15. The apparatus of claim 10, wherein the plurality of subcarriers are contiguous subcarriers or interleaved subcarriers.

Claim 16. The apparatus of claim 10, wherein encoding comprises multiplying a vector or matrix of data symbols with a vector or matrix comprising the first set of complex-valued codes.

Claim 17. The apparatus of claim 10, wherein applying comprises modulating the encoded data symbols onto the plurality of subcarriers.

Claim 18. The apparatus of claim 10, wherein the non-transitory computer-readable memory further includes instructions stored thereon and executable by the processor for adding a cyclic prefix to the spread-OFDM signal before transmitting the spread-OFDM signal.

Claim 19. [19Pre] A computer program product for operating a transmitter in a wireless communication network that employs a first set of complex-valued codes to encode data symbols to be transmitted, and employs a second set of complex-

valued codes to recover transmitted data symbols from a received signal, the computer program product comprising a non-transitory computer readable storage device having computer readable program code stored therein, said program code containing instructions executable by one or more processors of a computer system for:

[19A] selecting a plurality of subcarriers to be transmitted;

[19B] encoding the data symbols with the first set of complex-valued codes to produce encoded data symbols;

[19C] applying the encoded data symbols to the plurality of subcarriers to produce a spread-Orthogonal Frequency Division Multiplexing (OFDM) signal; and

[19D] transmitting the spread-OFDM signal;

[19E] wherein the first set of complex-valued codes are complex conjugates of the second set of complex-valued codes.

Claim 20. The computer program product of claim 19, wherein selecting is responsive to spectrum allocation or is configured to provide for orthogonal frequency division multiple access.

Claim 24. The computer program product of claim 19, wherein the plurality of subcarriers are contiguous subcarriers or interleaved subcarriers.

Claim 25. The computer program product of claim 19, wherein encoding comprises multiplying a vector or matrix of data symbols with a vector or matrix comprising

the first set of complex-valued codes.

Claim 26. The computer program product of claim 19, wherein applying comprises modulating the encoded data symbols onto the plurality of subcarriers.

Claim 27. The computer program product of claim 19, wherein said program code further includes instructions executable by the one or more processors of the computer system for adding a cyclic prefix to the spread-OFDM signal before transmitting the spread-OFDM signal.

PETITIONER’S EXHIBIT LIST

Exhibit No.	Description
1001	U.S. Patent No. 11,075,786
1002	Declaration of Harry Bims, Ph.D.
1003	RESERVED
1004	Dirk Galda & Hermann Rohling, <i>A Low Complexity Transmitter Structure for OFDM-FDMA Uplink Systems</i> , Vehicular Technology Conference. IEEE 55 th Vehicular Technology Conference, vol. 4, pp.1737-1741 (May 6, 2002) (“Galda”).
1005	Stefan Kaiser, <i>Multi-Carrier CDMA Mobile Radio Systems – Analysis and Optimization of Detection, Decoding, and Channel Estimation</i> , VDI-Verlag, Dusseldorf, Germany (Jan. 1998) (ISBN 3-18-353110-0) (“Kaiser”)
1006	RESERVED
1007	Andres Bury & Jurgen Linder, <i>Comparison of Amplitude Distributions for Hadamard Spreading and Fourier Spreading in Multi-Carrier Code Division Multiplexing</i> , Globecom ’00-IEEE. Global Telecommunications Conference, Vol. 2, pp.857-860 (Nov. 27, 2000) (“Bury”)
1008	Kwang-Cheng Chen, et al., <i>A Programmable Architecture for OFDM-CDMA</i> , IEEE Communications Magazine, pp.76-82 (Nov. 1999) (“Chen”)
1009	RESERVED
1010	RESERVED
1011	U.S. Patent Application Publication No. 2003/0081538 to Walton et al.
1012	Declaration of Sylvia Hall-Ellis, Ph.D.
1013	RESERVED
1014	Stephen B. Weinstein, <i>The History of Orthogonal Frequency-Division Multiplexing</i> , IEEE Communications Magazine, pp.26-

Exhibit No.	Description
	35 (Nov. 2009).
1015	Richard van Nee & Ramjee Prasad, <i>OFDM for Wireless Multimedia Communications</i> (Artech House 2000).
1016	Karsten Bruninghaus & Herman Rohling, <i>Multi-carrier spread spectrum and its relationship to single-carrier transmission</i> , Vehicular Technology Conference. IEEE 48 th Vehicular Technology Conference, vol. 3, pp.2329-2332 (May 18-21, 1998) (“Brüninghaus”).
1017	RESERVED
1018	RESERVED
1019	File History of U.S. Patent Application No. 14/967,633 as obtained from Patent Center (excerpts).
1020	RESERVED
1021	File History of U.S. Patent Application No. 11/187,107 as obtained from Patent Center (excerpts).
1022	RESERVED
1023	File History of U.S. Patent Application No. 10/145,854 as obtained from Patent Center (excerpts).
1024	U.S. Patent No. 8,670,390
1025	U.S. Patent No. 8,750,264
1026	RESERVED
1027	RESERVED
1028	RESERVED
1029	RESERVED
1030	File History of U.S. Patent Application No. 14/727,769 as obtained from Patent Center (excerpts)
1031	File History of U.S. Patent Application No. 14/276,309 as obtained from Patent Center (excerpts)

Exhibit No.	Description
1032	File History of U.S. Patent Application No. 12/545,572 as obtained from Patent Center (excerpts)
1033	RESERVED
1034	RESERVED
1035	RESERVED
1036	File History of U.S. Patent Application No. 15/489,644 as obtained from Patent Center (excerpts)
1037	File History of U.S. Patent Application No. 15/149,382 as obtained from Patent Center (excerpts)
1038	3GPP TS 36.211 V8.8.0 (2009-09) 3 rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation (Release 8)
1039	Exhibit 1 to Plaintiff's P.R. 3-1(c) Infringement Contentions (U.S. Pat. No. 9,768,842)
1040	RESERVED
1041	RESERVED
1042	U.S. Patent No. 6,597,745 to Dowling
1043	Gerhard P. Fettweis, et al., <i>A Time Domain View to Multi-Carrier Spread Spectrum</i> , IEEE 6 th Int'l Symposium on Spread-Spectrum & Applications (ISSSTA 2000), (Sept. 6-8, 2000) (pre-print)
1044	Armin Dekorsy & Volker Kuehn, <i>Exploiting Time and Frequency Diversity by Iterative Decoding in OFDM-CDMA Systems</i> , Seamless Interconnection for Universal Services, Global Telecommunications Conference. GLOBECOM'99, Vol. 5, pp.2576-2580 (Dec. 5, 1999).
1045	Volker Kuehn, et al., <i>Channel Coding Aspects in an OFDM-CDMA System</i> , ITG FACHBRICHT, pp.31-36 (Jan. 2000).

Exhibit No.	Description
1046	Docket Control Order, <i>Genghiscomm Holdings, LLC v. Samsung Elecs., Am., Inc.</i> , No. 2:24-cv-0242-RWS-RSP, Dkt. 25 (Sept. 24, 2024).
1047	Complaint, <i>Genghiscomm Holdings, LLC v. Samsung Elecs., Am., Inc.</i> , No. 2:24-cv-0242-RWS-RSP, Dkt. 1 (Apr. 12, 2024).
1048	RESERVED
1049	RESERVED
1050	RESERVED
1051	RESERVED
1052	RESERVED
1053	RESERVED
1054	RESERVED
1055	RESERVED
1056	RESERVED
1057	RESERVED
1058	RESERVED
1059	Declaration of Gary Swatzell including Exhibits A-D
1060	Guidance on USPTO’s rescission of “Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation” (Mar. 24, 2025).
1061	Docket Control Order, <i>Slyde Analytics LLC v. Apple Inc.</i> , No. 2:24-cv-00331-RWS-RSP, Dkt. 46 (E.D. Tex. Sept. 23, 2024)
1062	Docket Control Order, <i>Innomemory, LLC v. Truis Financial Corp.</i> , No. 2:24-cv-00146-RWS-RSP, Dkt. 38 (E.D. Tex. Sept. 24, 2024)
1063	Docket Control Order, <i>Husky Injection Molding Systems Ltd. V. Ningbo Ao Sheng Mold Co., Ltd. D/B/A Aosimi</i> , No. 2:24-cv-00348-RWS-RSP, Dkt. 46 (E.D. Tex. Oct. 21, 2024)

Exhibit No.	Description
1064	Docket Sheet for <i>Partec Ag, et al v. Microsoft Corporation</i> , No. 2:24-cv-00433 (downloaded Mar. 25, 2025).
1065	Combined asserted patents in <i>Genghiscomm Holdings, LLC v. Samsung Elecs., Am., Inc.</i> , No. 2:24-cv-0242-RWS-RSP, Dkt. 25 (Sept. 24, 2024).
1066	File History of U.S. Patent Application No. 16/796,888 as obtained from Patent Center (excerpts).
1067	File History of U.S. Patent Application No. 16/199,221 as obtained from Patent Center (excerpts).
1068	File History of U.S. Patent Application No. 16/027,191 as obtained from Patent Center (excerpts).
1069	File History of U.S. Patent Application No. 15/642,850 as obtained from Patent Center (excerpts).
1070	RESERVED
1071	RESERVED
1072	RESERVED
1073	A. Gusmão, et al., <i>Comparison of Two Modulation Choices for Broadband Wireless Communications</i> , VTC2000-Spring. 2000 IEEE 51 st Vehicular Technology Conference Proceedings, Vol. 2, pp.1300-1305 (May 15, 2000).
1074	Exhibit 4 to Plaintiff's P.R. 3-1(c) Infringement Contentions (U.S. Pat. No. 11,075,786)
1075	U.S. Patent No. 11,700,162 to Shattil
1076	RESERVED
1077	U.S. Patent No. 7,436,896
1078	Results of Docket Navigator Search for '786 Patent
1079	RESERVED

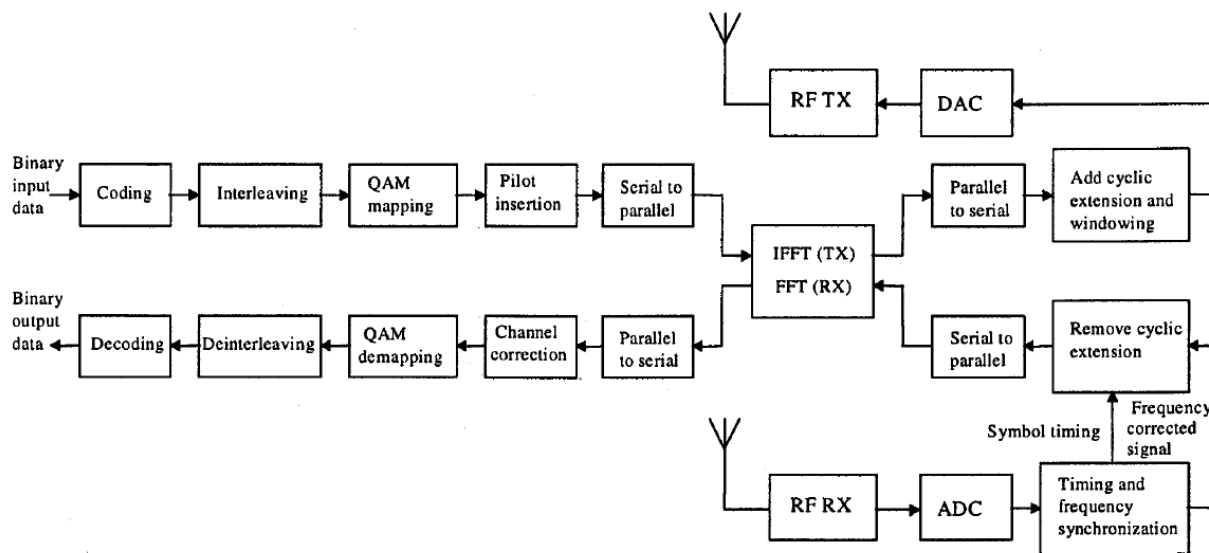
I. GROUNDS FOR STANDING

Petitioner has standing to bring this challenge. Neither it nor any privy or real party-in-interest was served with a Complaint more than one year before the filing of this Petition and it is not estopped from bringing this challenge.

II. TECHNICAL OVERVIEW

The Challenged Patent relates to processes for use in orthogonal frequency division multiplexing (“OFDM”) wireless communications. OFDM has been studied for more than 50 years. EX1014, pp.26-28; EX1015, pp.20-24.

A textbook OFDM transceiver is shown below.



EX1015, p.48. An OFDM signal is formed at the transmitter using an inverse Fourier transform, *e.g.*, an inverse fast Fourier transform (“IFFT”). *Id.*, pp.42, 47-48. A guard interval including a cyclic prefix is added to minimize intersymbol

interference (“ISI”) and intercarrier interference (“ICI”). *Id.*, pp.39-40.

III. THE ’786 PATENT

A. Overview

The ’786 Patent is titled “Multicarrier sub-layer for direct sequence channel and multiple-access coding” and describes a “CI Multiple-Access Transceiver.” EX1001, cover. The ’786 Patent discloses that “[a]n information signal, such as a stream of data bits or data symbols may be processed with an optional coder/interleaver 4001” and “[d]ata symbols are coupled to a CI encoder 4002, such as a modulator, that impresses the data symbols onto at least one CI code generated by a CI-code generator 4003.” EX1001, 78:6-54. An example of the CI transceiver is shown in Fig. 40A below.

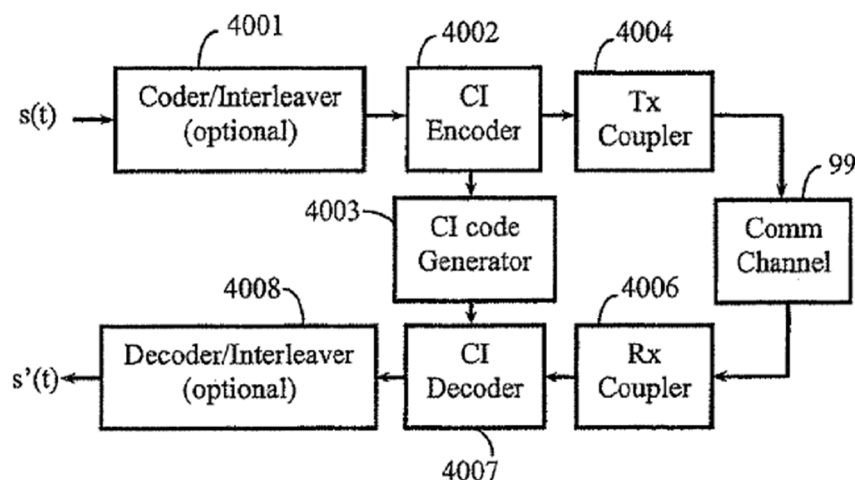


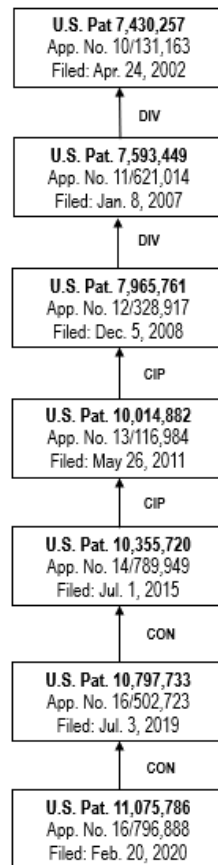
FIG. 40A

EX1001, FIG. 40A. The challenged claims encompass systems and methods that

implement complex-valued spreading (e.g., DFT spreading) and OFDM modulation in wireless communications.

B. Prosecution History

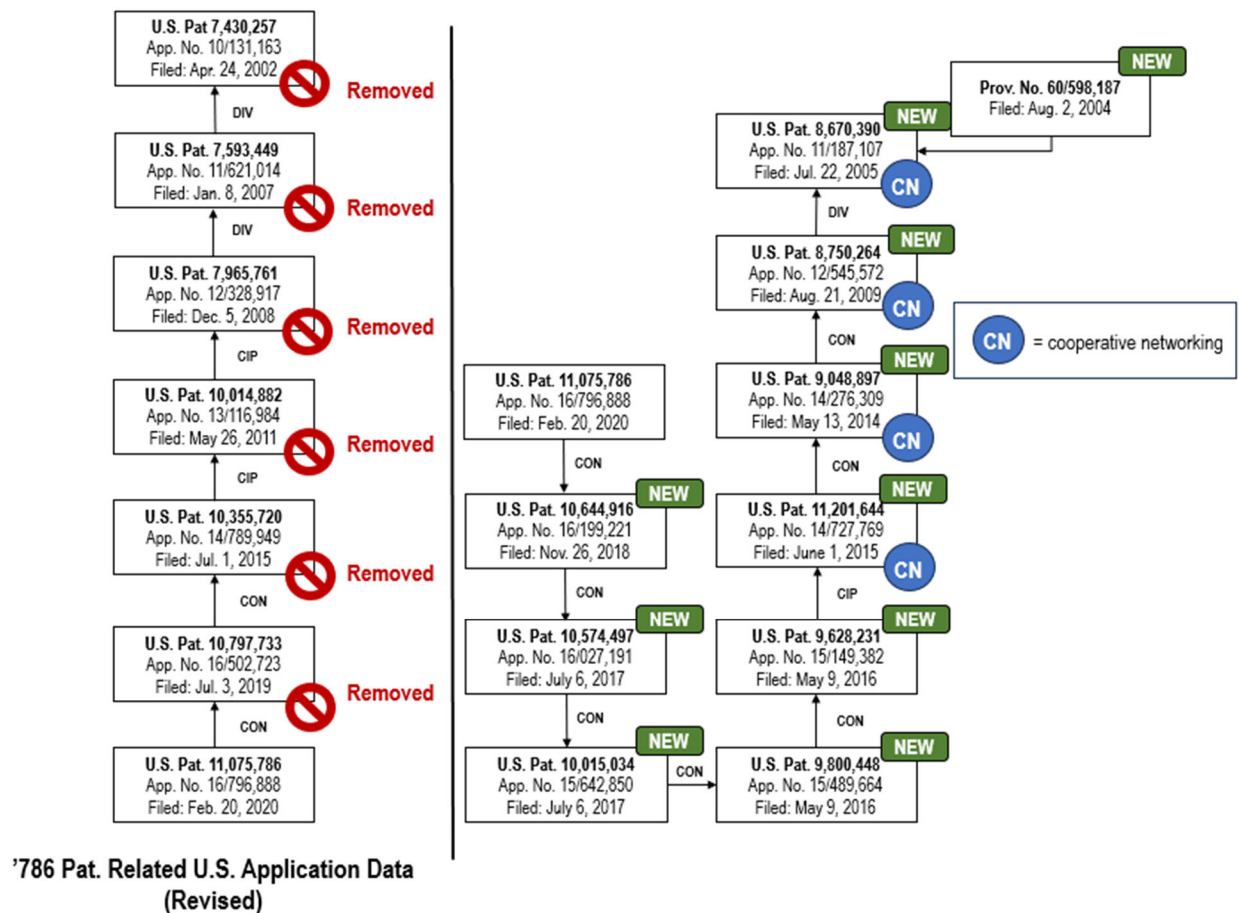
The application for the '786 Patent underwent a wholesale change in the priority claim a few months after it was filed. When U.S. Patent Application No. 16/796,888 ("888 Application") was filed it claimed the benefit of six applications dating back to April 24, 2002:



**'786 Pat. Related U.S. Application Data
(Original)**

EX1066, p.57-58, 64.

Three months after the '888 Application was filed, the domestic benefit claim was replaced to claim priority to ten different applications with a different earliest effective filing date:



EX1066, pp.37-39, 47-48. We address only the revised priority claim here.

Despite eleven applications in the family, the Examiner was not presented with any of the highly material prior art raised in this Petition.

1. Application No. 16/796,888 (Challenged Patent)

Besides the modification of the priority claim, the '888 Application

prosecution history is unremarkable. The '888 Application was allowed on first action. EX1066, pp.17-18. In the reasons for allowance, the Examiner highlighted the application of “encoded data symbols to the plurality of subcarriers” to produce the OFDM signal, transmitting that signal, and the requirement that the “complex valued codes are complex conjugates of the second set of complex valued codes” along with “all disclosed steps of [sic] functions or all disclosed structures performing corresponding functions” recited in the claims. EX1066, p.18.

2. Application No. 16/199,221

The '221 Application includes similar claims to those of the '786 Patent. The originally filed claims of the '221 Application were rejected under §101 for patent ineligibility and for obviousness-type double patenting over claims of U.S. Patent No. 10,211,892. EX1067, pp.31-34. The claims were allowed without any indication by the Office about why they were deemed patentable over the prior art. *Id.*, p.15-16.

3. Application No. 16/027,191

The '191 Application includes claims that also bear some similarity to those of the '786 Patent. The claims were rejected for obviousness-type double patenting over claims of U.S. Patent No. 10,211,892. EX1068, pp.49-52. A terminal disclaimer was filed, and the claims were allowed without any indication by the Office about why they were deemed patentable over the prior art. *Id.*, p.19.

4. Application No. 15/642,850

The '850 Application was filed with a preliminary amendment that included mathematical expressions found nowhere in the '850 Application's text, but instead were copied from the 4G LTE standards. *E.g.*, EX1069, pp.70-71; EX1038, pp.8-9, 14-15, 31. The claims were rejected for obviousness-type double patenting over U.S. Patent No. 9,800,448 and a terminal disclaimer was filed. EX1069, pp.40, 45-47. The Examiner allowed the claims and explained that the prior art failed to disclose generation of an OFDM signal comprising a "superposition of the plurality of OFDM subcarriers modulated by the spread symbols," a "transform precoder" that "generates the plurality of orthogonal spreading codes" to provide the superposition with reduced PAPR, and the "precoder and the mobile access resource mapper" being configured to weight each OFDM subcarrier with an amplitude scaling factor along with all other steps/functions/structures of the claims. EX1069, p.22.

5. U.S. Patent Application No. 15/489,644

The '644 Application was accompanied by a preliminary amendment that canceled all claims and rewrote many of the claims to copy expressions from the 4G LTE standards. For example, claim 28 provided the following expression for a "spread symbol" that is not found in the specification of the earlier applications in the family or the '644 Application itself:

$$z(l \cdot M_{SC}^{PUSCH} + k) = \frac{1}{\sqrt{M_{SC}^{PUSCH}}} \sum_{i=0}^{M_{SC}^{PUSCH}-1} d(l \cdot M_{SC}^{PUSCH} + i) e^{-j \frac{2\pi i k}{M_{SC}^{PUSCH}}}$$

EX1036, p.32. The Examiner indicated this (and other) claims were allowable and Applicant amended the claims to incorporate this mathematical expression. *Id.*, pp.6, 9, 20. This mathematical expression was reflected in the reasons for allowance. *Id.* None of the prior art applied herein was raised during prosecution of the '644 Application.

6. U.S. Patent Application No. 15/149,382

The '382 Application had two office actions rejecting claims using references to Kim, Larioa, and Baum. EX1037, pp.33-39, 57-63. In response, Applicant argued that Baum was not prior art. *Id.*, pp.22-28. The Examiner agreed and allowed the claims. In doing so, the Examiner focused on the “DFT spreader” and “subcarrier mapper” limitations of the claims when the '382 Application as reflecting allowable subject matter. EX1037, p.9.

7. U.S. Patent Application Nos. 14/727,769, 14/276,309, 12/545,572, 11/187,107

These applications describe and claim aspects of cooperative networking involving multiple wireless terminals that cooperate in various ways to send and receive signals. They bear no material resemblance to the claims of the Challenged patent. EX1021, EX1030, EX1031, EX1032.

IV. EFFECTIVE FILING DATE; POST-AIA

The '786 Patent is not entitled to its claimed effective filing date of August 2, 2004. The '786 Patent is also not a pre-AIA patent. Petitioner has taken these positions in litigation. Nevertheless, for the challenges presented herein all references qualify as prior art under 35 U.S.C. §§102(b) or 102(a)(1), and as such they cannot be antedated. Thus, the correct effective filing date of the claimed subject matter is not material to the outcome of this proceeding and Petitioner does not elaborate further on the matter in this Petition while reserving its right to do if necessary during trial.

V. IDENTIFICATION OF THE CHALLENGE AND THE PERSON OF ORDINARY SKILL IN THE ART (“POSITA”)

Petitioner challenges claims 1, 2, and 6-11, 15-18, 19-20, and 24-27 (“Challenged Claims”) on the following grounds:

Ground	Claims	Challenge	Statute
1	1, 2, and 6-9	Obviousness over Galda in view of Brüninghaus	Post- or Pre-AIA §103
2	10-11, 15-18, 19-20, and 24-27	Obviousness over Galda in view of Brüninghaus and Dowling	
3	1, 2, and 6-9	Obviousness over Kaiser in view of Bury	
4	10-11, 15-18, 19-20, and 24-	Obviousness over Kaiser in view of Bury and Dowling	

Ground	Claims	Challenge	Statute
	27		

Based on the '786 Patent, the prior art and other documentation cited herein, and on Dr. Bims's testimony, a POSITA as of Aug. 2, 2004 would have had "either a Master's degree in electrical engineering or a related field, or a Bachelor's degree in electrical engineering or a related field with three years of experience in wireless communication systems, signal processing, and related technologies." EX1002, ¶48. This level of skill does not materially change regardless of the effective filing date. *Id.*, ¶¶48-52.

VI. CLAIM CONSTRUCTION

Petitioner submits that no formal claim constructions are necessary because "claim terms need only be construed to the extent necessary to resolve the controversy." *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011). Petitioner reserves the right to respond to any constructions offered by Patent Owner or adopted by the Board.

VII. PRIOR ART STATUS OF THE REFERENCES; ANALOGOUS ART

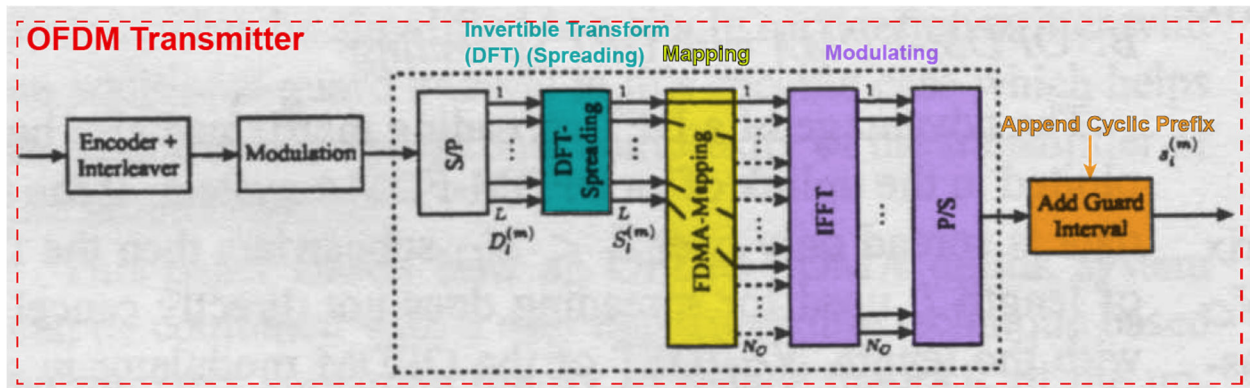
The '786 Patent claims priority to US Provisional Application No. 60/598,187, filed Aug. 2, 2004. Each reference discussed below and relied upon in the challenges is analogous prior art and in the same field of endeavor as the '786

Patent. EX1002, ¶53.

A. Galda

Galda is a prior art printed publication because it was distributed and thus accessible to those skilled in the art between May 6th to 9th on CD ROM to as many as 400 attendees at IEEE's 55th Vehicular Technology Conference in Birmingham, Alabama. EX1059, ¶¶4-10. The "main focus" of the conference was "voice and data wireless mobile communications," *Id.*, ¶6, and there were more than 100 presenters skilled in the field at the conference. *Id.* CD ROMs were given to attendees when they checked in for the conference and included as part of the conference registration fee. *Id.*, ¶¶7-10, 11 (Exhibit D). The conference was open to the public and there were no confidentiality restrictions imposed on the conference proceedings, EX1059, ¶¶11-12, and it was expected that the proceedings would be shared widely as confirmed by the fact that the conference proceedings were cataloged into the Linda-Hall Library of Science, Engineering, and Technology less than two months later, then made available on the IEEE website by August 7, 2002. See EX1012, Declaration of Dr. Hall-Ellis, ¶¶51-54 (describing her research and findings with respect to the Galda reference); EX1002, ¶¶54-56. Galda is thus a prior art printed publication by at least May 6, 2002 and is prior art under pre-AIA §§ 102 (b) or post-AIA § 102(a)(1).

Galda teaches reducing PAPR (PAR) using “OFDM-FDMA multiple access ... combined with a data spreading technique based on a Discrete Fourier Transform. Spreading matrix using only the user specific subcarriers.” EX1004, p.1737. Galda’s transmitter is illustrated below.



Id., p.1740 (annotated).¹

Galda is analogous art to the '786 Patent because it is in the field of multi-carrier spread spectrum communications. EX1001, 1:35-38; EX1004, p.1737 (describing “spreading over the subcarriers assigned to one user”); EX1002, ¶56. Both the '786 Patent and Galda describe applying coefficients to data symbols to spread them over subcarriers in the frequency domain. EX1001, 6:48-50; EX1004, pp.1737, 1739 (using “elements of the discrete Fourier matrix”), 1740, Fig. 6(a); EX1002, ¶56. Galda is also analogous art because one of the problems facing the

¹ Color highlights and color text herein are Petitioner’s annotations unless otherwise noted.

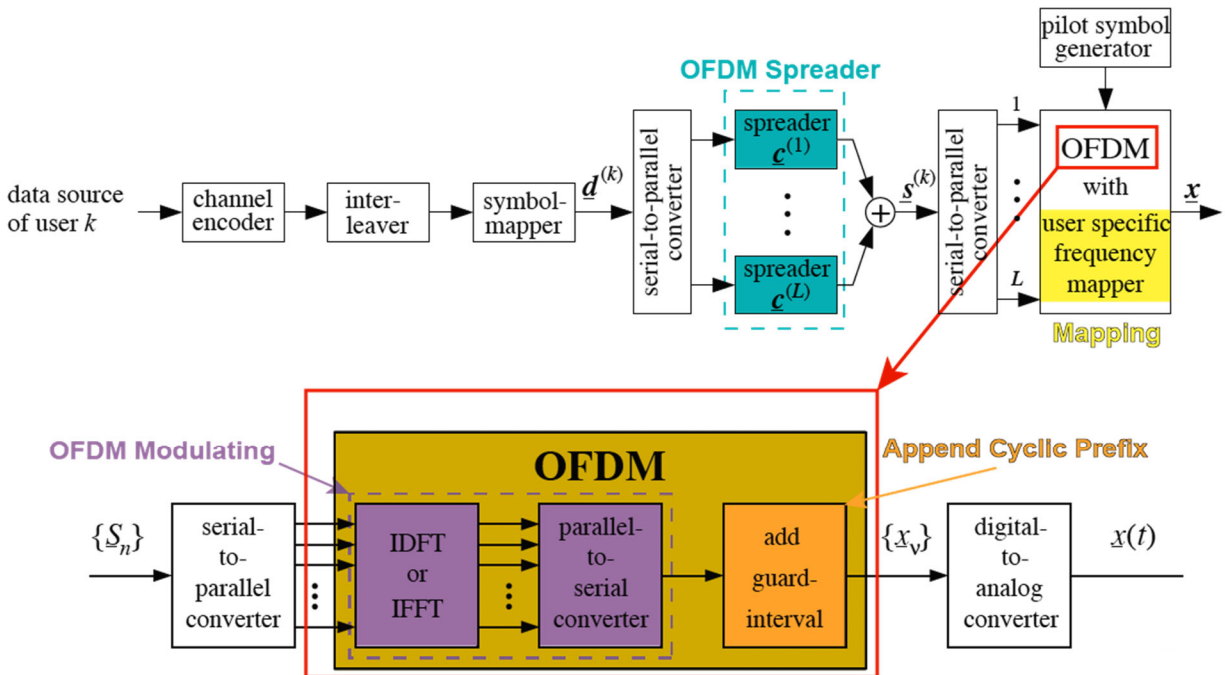
inventor was reducing PAPR in OFDM communications, EX1001, 66:43-44 (“CI-OFDM eliminates problems of high PAPR.”), and Galda seeks to solve that problem by spreading data symbols using complex-valued codes from a DFT before applying OFDM modulation using an IFFT, EX1004, pp.1737, 1739-1740; EX1002, ¶56.

B. Kaiser

Kaiser is a Ph.D. thesis titled “*Multi-Carrier CDMA Mobile Radio Systems – Analysis and Optimization of Detection, Decoding, and Channel Estimation*,” issued by the Department of Computer Science and Engineering at the Technische Universität München (Dusseldorf, Germany) and published by VDI-Verlag, Dusseldorf, Germany. EX1005. Kaiser bears January 1998 publication date. *Id.*, cover. Kaiser was cataloged by the Bavarian Library Network in its online catalog by April 15, 1998 and into the Bibliothèque Scientifique Nationale / National Research Council Library (Ottawa, Ontario, Canada) by July 6, 1998. EX1012, ¶48. Kaiser was cataloged by subject matter using terms that a POSITA would have reasonably used to locate Kaiser. EX1012, ¶49; EX1002, ¶¶57-59. As further evidence of Kaiser’s availability, numerous articles cite to Kaiser. EX1043, p.4 (reference [14]), EX1044, p.6 (reference [2]), EX1045, p.6 (reference [4]). Kaiser is thus prior art under pre-AIA §102(b) or post-AIA §102(a)(1).

Kaiser discloses an OFDM transmitter comprising an OFDM spreader block, “user-specific frequency mapper,” and an OFDM transmission block that includes

an IDFT/IFFT, parallel-to-serial converter, and a block for adding a guard interval (cyclic prefix):



EX1005, pp.34, 132 (Figs. B.2 & 3.2).²

Kaiser is analogous to the '786 Patent because it is in the field of multi-carrier spread spectrum communications. EX1001, 1:35-38; EX1005, pp.130-37 (describing spread spectrum multiple access); EX1002, ¶59. Kaiser is also analogous

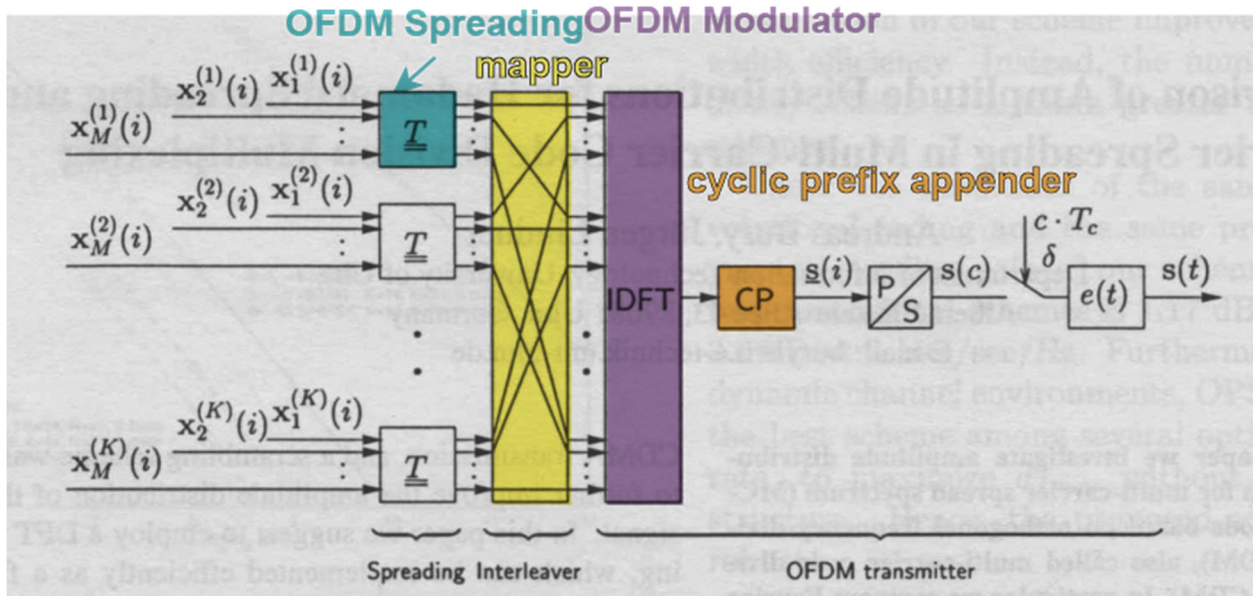
² This Figure combines two figures in Kaiser: Figure B-2, which discloses an “OFDM” element, and Figure 3.2 from Chapter 3, §3.1.1. EX1005, pp.34, 132. Kaiser teaches that the OFDM steps are applied in the SS-MC-MA transmitter in the same manner discussed in §3.1.1. EX1005, pp.132-133.

because one of the problems facing the inventor was to achieve more efficient use of bandwidth in communication systems, EX1001, Abstract (“[B]andwidth efficiency of multicarrier protocols is greatly enhanced with CI.”), 5:41-42 (“CI avoids the problem of reduced bandwidth efficiency...”). Kaiser is reasonably pertinent to this problem because it achieves “high bandwidth efficiency and great flexibility” using SS-MC-MA in the uplink. EX1005, p.137; EX1002, ¶59.

C. Bury

Bury is a conference paper from the IEEE Global Telecommunications Conference. EX1007. Exhibit 1007 was obtained from the Linda Hall Library, which entered it into its catalog by January 12, 2001. EX1012, ¶¶58, 60-61. Bury was cataloged by subject matter as indicated in the records identified by Dr. Hall-Ellis and based on the subject matter categories, a POSITA would have been able to find Bury with the exercise of reasonable diligence. EX1012, ¶¶37, 63-64; EX1002, ¶60. Bury is thus prior art under pre-AIA §102(b) or post-AIA §102(a)(1).

Bury discloses an OFDM transmitter in Figure 1 including a spreader with an invertible transform (a DFT matrix), a mapping block, an IDFT/OFDM modulator block, and a block for appending a cyclic prefix:



EX1007, p.858 (Fig. 1(a)). Bury further teaches that DFT-spreading codes/matrices should be used instead of conventional Walsh-Hadamard codes to improve overall performance by reducing peak-to-average power ratio (PAPR). EX1007, pp.857, 860.

Bury is analogous art to the '786 Patent because it is in the field of multi-carrier spread spectrum communications. EX1001, 1:35-38; EX1007, p.857 (referring to “multi-carrier spread spectrum (MC-SS) transmission methods based on” OFDM). EX1002, ¶¶610-63. Bury is also analogous because one of the problems facing the inventor was reducing PAPR in OFDM communications, EX1001, 66:43-44 (“CI-OFDM eliminates problems of high PAPR.”), and Bury seeks to solve that problem by spreading symbols using complex-valued codes from a DFT, EX1007, pp.857, 860; EX1002, ¶¶63.

D. Brüninghaus

Brüninghaus is a conference paper from the 48th IEEE Vehicular Technology Conference held in May 1998. EX1016, p.1. Exhibit 1016 was obtained from the Linda Hall Library. EX1012, ¶72. It was cataloged into that library as of July 16, 1998. EX1012, ¶75. It was cataloged by subject matter including “Mobile communication systems *vs* Congresses,” which would have been sufficient to allow for a POSITA to locate Brüninghaus based on subject matter. EX1012, ¶77; EX1002, ¶645. As a further indication of its accessibility to those skilled in the art, Brüninghaus has been cited in other scholarly works. EX1073, p.1305 (reference [7]); EX1004, p.1741 (reference [3]); EX1007, p.860 (reference [4]). Brüninghaus is thus prior art under pre-AIA §102(b) or post-AIA §102(a)(1).

Brüninghaus describes that “[t]he combination of orthogonal frequency division multiplexing (OFDM) and code division multiplexing (CDM) has found great interest during the last few years.” EX1016, p.2329. Brüninghaus also discloses that “[s]ince the single-carrier system which results from an OFDMCDM system with Fourier spreading matrix is a special case of an OFDM-CDM system, the same detection algorithms can be applied and the same performance can be expected.” *Id.*, p.2330. “In case of a Fourier spreading matrix, despreading in the receiver is achieved by an inverse Fast-Fourier matrix, i.e. $[H]^H = [\text{IFFT}]$.” EX1016, p.2330.

Brüninghaus is analogous to the '786 patent because they share the same field including multi-carrier spread spectrum communications. EX1001, 1:35-38; EX1016, p.2329 (titled: “Multi-Carrier Spread Spectrum”); EX1002, ¶¶64-66. Brüninghaus is also analogous because one of the problems facing the inventor was reducing transceiver complexity, EX1001, Abstract (“CI-based ultra-wideband protocols are implemented via frequency-domain processing to reduce ... transceiver complexity....”), 6:67-66, and Brüninghaus achieves an equivalent single-carrier system with reduced computational complexity, EX1016, p.2330; EX1002, ¶66.

E. Dowling

Dowling was filed on April 6, 1999 and issued July 22, 2003. EX1042, cover. Dowling is prior art under post-AIA §102(a)(1) or pre-AIA §102(e).

Dowling discloses multicarrier modulation and OFDM systems that may be implemented as software modules executing on programmable processors. Dowling’s transmitters, receivers, and precoders may be implemented in either hardware or software. EX1042-Dowling, 3:46-50, 5:66-6:1.

Dowling is analogous to the '786 Patent at least because it is in the same field of endeavor including multicarrier systems. EX1001, 1:35-38 (referring to the “field” as including “multicarrier spread spectrum communications”); EX1042, 1:6-12 (“field” relates to “data transmission,” more specifically to for multicarrier (e.g.,

OFDM) systems), 21:62-64 (invention “applied to other FFT based multicarrier modulation and OFDM systems.”); EX1002, ¶¶67-69. Dowling is also reasonably pertinent to a problem faced by the inventor including reducing the complexity in a transmitter. EX1001, Abstract (“CI-based ultra-wideband protocols are implemented via frequency-domain processing to reduce ... transceiver complexity...”), 6:67-66; EX1042, 1:7-10 (“[T]he invention relates to a reduced complexity precoder method and apparatus for multicarrier systems.”); EX1002, ¶69.

VIII. DETAILED DISCUSSION

A. Ground 1: Claims 1, 2, and 6-9 are obvious over Galda in view of Brüninghaus

1. Claim 1

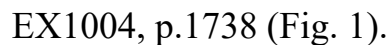
- a. **[1Pre] A method of communication in a wireless communication network that employs a first set of complex-valued codes to encode data symbols to be transmitted, and employs a second set of complex-valued codes to recover transmitted data symbols from a received signal, the method comprising**

Preambles are not generally limiting. *Arctic Cat Inc. v. GEP Power Prod., Inc.*, 919 F.3d 1320, 1327-1328 (Fed. Cir. 2019). A preamble may be limiting if it “recites essential structure or steps, or if it is necessary to give life, meaning, and vitality to the claim.” *Id.* “When limitations in the body of the claim rely upon and derive antecedent basis from the preamble, then the preamble may act as a necessary

component of the claimed invention.” *Pacing Techs., LLC v. Garmin Int’l, Inc.*, 778 F.3d 1021, 1024-1025 (Fed. Cir. 2015).

Assuming claim 1’s preamble is limiting, Galda in view of Brüninghaus renders obvious the claimed *method of communication in a wireless communication network* (Galda’s “Mobile Terminal” transmits to “Base Station”) *that employs a first set of complex-valued codes* (Galda’s DFT coefficients; Brüninghaus’ “Fourier matrix” coefficients) to encode data symbols to be transmitted (Galda’s L complex modulation symbols $D_l^{(m)}$, $l = 0, \dots, L - 1$), *and employs a second set of complex-valued codes to recover transmitted data symbols from a received signal* (Brüninghaus explains that the receiver applies the “inverse Fast-Fourier matrix, i.e. $[H]^H = [\text{IFFT}]$ ” to perform “despreading” as explained in more detail in Limitation [1E]). EX1002, ¶¶70-74.

Galda’s OFDM system spreads data symbols with “a Discrete Fourier Transform (DFT) spreading matrix” before mapping and OFDM modulation, and ultimately *communication in a wireless transmission network* as shown below where “Mobile Terminal” transmits wirelessly to “Base Station”:



Galda *employs a first set of complex-valued codes to encode data symbols to be transmitted* because it explains that “ L complex modulation symbols $D_l^{(m)}$, $l = 0, \dots, L - 1 \dots$ are spread over the L user specifically allocated subcarrier with a unitary spreading matrix $[C]$ resulting in L complex transmit symbols $S_l^{(m)}$.” EX1004, p.1738. Galda’s “elements of the discrete Fourier matrix” are *complex-valued codes* because they take the form:

$$C_{i,j} = \left(\frac{1}{\sqrt{L}}\right) \cdot e^{j2\pi i j/L}$$

EX1004, p.1739; EX1002, ¶72. When *data symbols* $D_l^{(m)}$, $l = 0, \dots, L - 1$ are

multiplied by the elements of the Fourier matrix, it *encodes* the data symbols to be transmitted by spreading them. EX1002, ¶73.

Galda in view of Brüninghaus renders obvious employing *a second set of complex-valued codes to recover transmitted data symbols from a received signal*.

Galda shows receiving a time-domain waveform $r_i^{(m)}$ corresponding to the time-domain waveform $s_i^{(m)}$. EX1004, pp.1738-39 (Fig. 1). This is the *received signal*.

EX1002, ¶74. Brüninghaus explains that “[i]n the receiver, the inverse processing is performed” and that when “the Fourier matrix is used as orthogonal code matrix,” the received signal can be despread “in the receiver ... by an inverse Fast-Fourier matrix” EX1016, pp.2329, 2330. As explained in more detail below, Brüninghaus’ inverse Fourier matrix includes *complex valued codes* that recover Galda’s *transmitted data symbols* from the *received signal*. See §VIII(A)(1)(c), (e), and (f); EX1002, ¶¶70-74. Accordingly, Galda in view of Brüninghaus renders obvious Limitation [1Pre].

b. [1A] selecting a plurality of subcarriers to be transmitted

Galda in view of Brüninghaus renders obvious *selecting a plurality of subcarriers to be transmitted*. EX1002, ¶¶75-78.

Galda explains that the transmission bandwidth is divided into “a set of orthogonal subcarriers” and that “distinct sets of subcarriers” are allocated “to

different users.” EX1004, p.1737. This allows bandwidth to be “flexibly shared between different mobile terminals while avoiding any multiple access interferences (MAI) between different users.” *Id.* This provides “high flexibility for the radio resource management (RRM)” *Id.*, p.1737. As Galda explains “the set of subcarrier[s] assigned to each user can be composed of any L out of N_C subcarrier that have not been assigned to another user.” *Id.*, p.1738. Galda’s transmitter performs *selecting a plurality of subcarriers to be transmitted* because, based on the allocation, Galda’s transmitter can “spread the user data over the allocated subcarrier only.” *Id.*, p.1737.

According to Galda, “each user allocates L different subcarrier[s] exclusively.” *Id.*, p.1738. Because the “user allocates” the L subcarriers, Galda describes *selecting a plurality of subcarriers* (i.e., L subcarriers from an available N_C subcarriers). These L subcarriers are *to be transmitted* because the “OFDM time signal of user m ” is summed across subcarriers $l=0$ to $L-1$, EX1004, p.1738 (equation (3)), and can be expressed similarly as signal $s_t^{(m)}$ which is the “transmit signal of user m ,” *id.*, p.1739 (equation (7)); EX1002, ¶77.

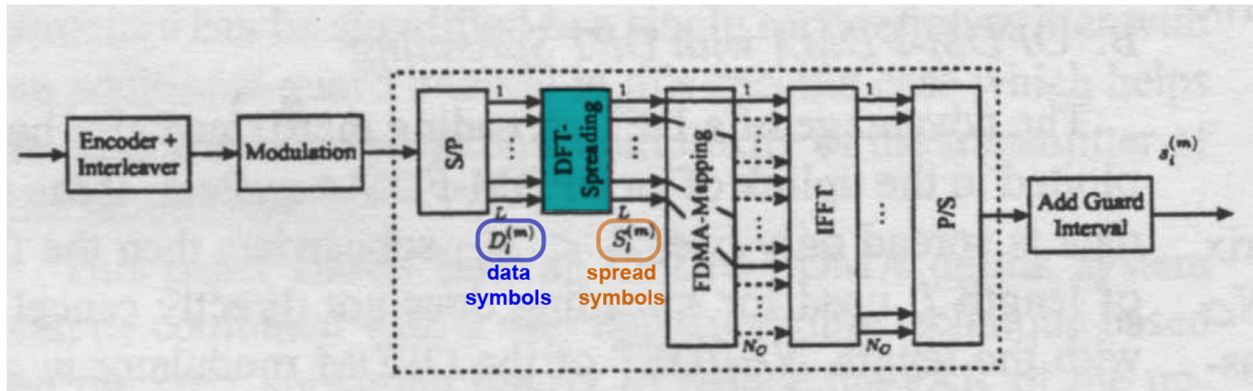
Therefore, Galda in view of Brüninghaus renders obvious limitation [1A].

c. [1B] encoding the data symbols with the first set of complex-valued codes to produce encoded data symbols

Galda in view of Brüninghaus renders obvious encoding the data symbols

with the first set of complex-valued codes to produce encoded data symbols encoding the **data symbols** with the **first set of complex-valued codes** to produce **encoded data symbols**. EX1002, ¶¶79-83.

Galda describes performing *encoding the data symbols with the first set of complex-valued codes* because vector of “complex modulation symbols,” i.e., **data symbols** “ $\vec{D}^{(m)}$ ” are multiplied by codes from **complex-valued code matrix** “[C]” to produce *encoded data symbols*—i.e., “complex transmit symbols” “ $\vec{S}^{(m)}$.” EX1004, p.1738; EX1002, ¶80. The encoding is performed in Galda’s “DFT-Spreading” block:



EX1004, p.1740 (Fig. 6(a)).

Galda’s complex-valued code matrix includes *first set of complex-valued codes* “ $C_{i,j}$ ” defined as:

$$C_{i,j} = \left(\frac{1}{\sqrt{L}} \right) \cdot e^{j2\pi ij/L}$$

EX1004, p.1739; EX1002, ¶81. At the very least, a POSITA would have found this expression to refer to complex-valued codes because as admitted by Patent Owner in co-pending litigation, exponential term “ $e^{j2\pi ij/L}$ ” is complex-valued because it includes “exponential function e ”). EX1004, p.1739; EX1074, p.9; EX1002, ¶82.

Accordingly, Galda in view of Brüninghaus renders obvious Limitation [1B].

d. [1C] applying the encoded data symbols to the plurality of subcarriers to produce a spread-Orthogonal Frequency Division Multiplexing (OFDM) signal

Galda in view of Brüninghaus renders obvious applying the encoded data symbols to the plurality of subcarriers to produce a spread-Orthogonal Frequency Division Multiplexing (OFDM) signal. EX1002, ¶¶84-86.

Galda’s “FDMA-Mapping” block applies the vector of “complex transmit symbol[s] $S_l^{(m)}$ ” “onto L of the available N_C subcarrier[s] which are exclusively allocated to user m .” EX1004, p.1738. This *applies the encoded data symbols* represented as **subcarrier values** “ $\vec{S}^{(m)}$ ” to the L subcarriers and inputs them into the IFFT block *to produce a spread-OFDM signal*—i.e., Galda’s **time-domain waveform** (“the resulting OFDM time signal of user m ” $s_l^{(m)}$). EX1004, p.1738; EX1002, ¶85. Galda’s time-domain waveform is reflected in the following mathematical expression:

$$s_i^{(m)} = e^{j2\pi im/N_C} \frac{1}{\sqrt{L}} \sum_{l=0}^{L-1} s_l^{(m)} e^{-j2\pi il/L} \quad (3)$$

for $i = -N_G, \dots, 0, \dots, N_G$,

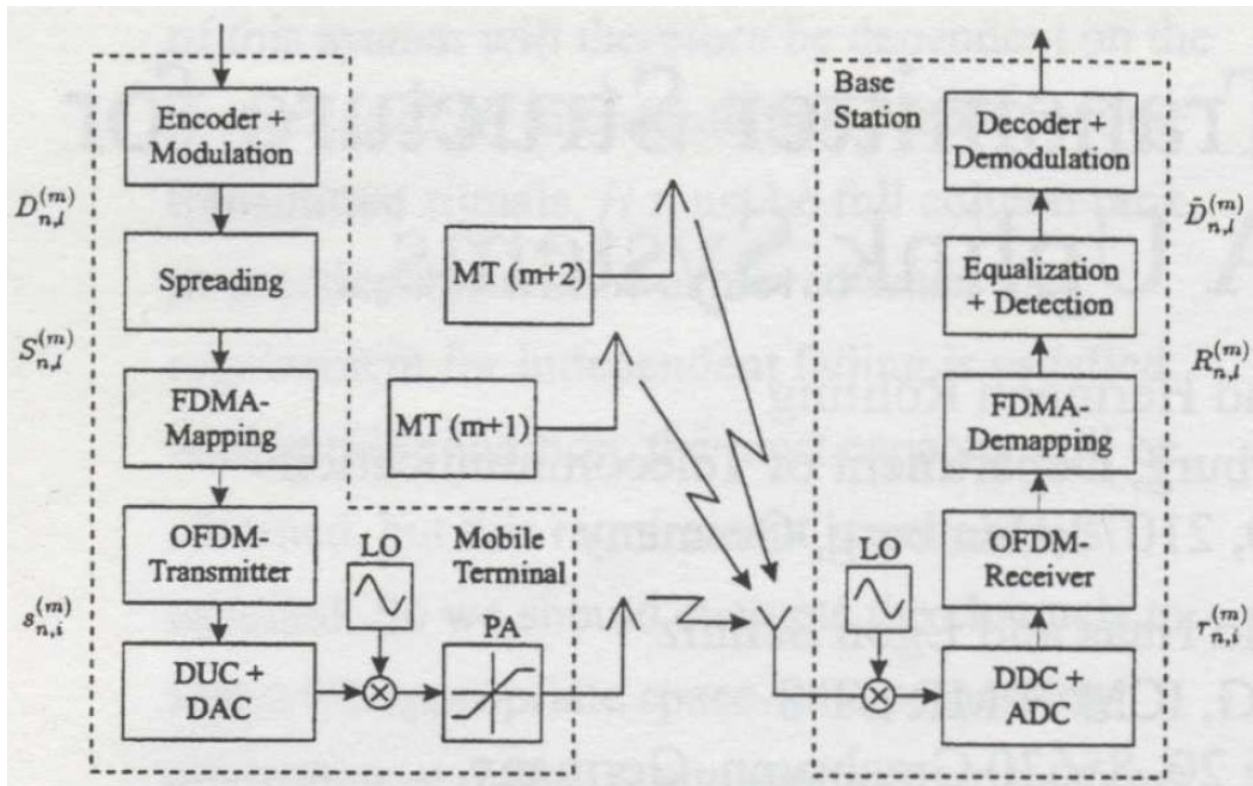
where the summation of subcarriers from $l = 0$ to L represents a superposition of the subcarriers modulated by the **set of subcarrier values** $s_l^{(m)}$. EX1004, pp.1738-1739; *see also id.*, p.1739 (providing alternative expression of “transmit signal of user m ”); EX1002, ¶85. Galda’s OFDM signal is *spread* because the “complex transmit symbols $s_l^{(m)}$ ” are DFT-spread. EX1002, ¶86.

Accordingly, Galda in view of Brüninghaus renders obvious Limitation [1C].

e. [1D] transmitting the spread-OFDM signal

Galda in view of Brüninghaus renders obvious *transmitting the spread-OFDM signal*. EX1002, ¶87-89.

Galda discloses a “low complexity transmitter structure for OFDMA-FDMA uplink structures.” EX1004, p.1737. Galda’s Fig. 1 shows spread OFDM signals being converted to analog form, being amplified (PA) and transmitted over the air to “Base Station.” EX1004, p.1738; EX1002, ¶88.



Accordingly, Galda in view of Brüninghaus renders obvious Limitation [1D].

- f. [1E] wherein the first set of complex-valued codes are complex conjugates of the second set of complex-valued codes.

Galda in view of Brüninghaus renders obvious *wherein the first set of complex-valued codes* (codes from Galda's "spreading matrix C," i.e., "elements of the discrete Fourier matrix," C_{ij}) *are complex conjugates of the second set of complex-valued codes* (Brüninghaus' "despreading in the receiver" which is "achieved by an inverse Fast-Fourier matrix, i.e. $[H]^H = [\text{IFFT}]$ "). EX1002, ¶¶90-98.

Galda discloses a "*first set of complex-valued codes*" (i.e., "elements of the discrete Fourier matrix" C_{ij} from matrix $[C]$), as explained above. *Supra* §91. Galda

does not expressly disclose that the *first set of complex-valued codes are complex conjugates of [a] second set of complex-valued codes* used “to recover transmitted data symbols from a received signal. EX1002, ¶91.

However, Galda implements DFT spreading from Brüninghaus, a paper that shares an author (Hermann Rohling) with Galda. EX1004, p.1739; EX1016, p.2329. Brüninghaus describes *[a] second set of complex-valued codes* that are used to (i.e., an IDFT despreading matrix). EX1004, 1739; EX1016, 2330 (“In case of a Fourier spreading matrix, despreading in the receiver is achieved by an inverse Fast-Fourier matrix, i.e. $[H]^H = [\text{IFFT}]$.”); EX1002, ¶92.

While Galda and Brüninghaus describe spreading using a DFT matrix, they use different mathematical notation. EX1002, ¶93. For example, Brüninghaus uses the following expression to describe its spreading operation:

$$s = [H] \cdot x \quad (1),$$

corresponds to the following equivalent expression in Galda:

$$\vec{S}^{(m)} = [C]\vec{D}^{(m)} \quad (1).$$

EX1016, p.2329; EX1004, p.1738; EX1002, ¶93. Brüninghaus’s “complex data symbols x ” (“vector of data symbols $x = (x_L, \dots, x_M)^T$ ”) corresponds to Galda’s **data symbols** $D_l^{(m)}$ and corresponding vector of data symbols ($\vec{D}^{(m)}$), Brüninghaus’s DFT “spreading matrix” “[H]” corresponds to Galda’s DFT “**spreading matrix**

[C]”, and Brüninghaus’s “modulation symbols” “s” is equivalent to Galda’s encoded data symbols “ $\vec{S}^{(m)}$.”³ EX1002, ¶94.

Galda’s “Base Station” receives time-domain waveform $r_i^{(m)}$ corresponding to the **time-domain waveform** $s_i^{(m)}$. EX1004, p.1739. Galda’s base station then processes received time-domain waveform in OFDM-Receiver “by removing the guard interval, calculating the Fourier transformation (FFT) which splits the time signal into the orthogonal subcarrier channels.” *Id.* Next “FDMA-Demapping” module “select[s] the user specific complex valued symbols $R_l^{(m)}$ at the FFT output” of the OFDM-Receiver. *Id.* Galda’s base station also includes an “Equalization + Detection” module that calculates $\tilde{D}_{n,l}^{(m)}$, which estimates the values of **data symbols** $D_l^{(m)}$. EX1004, p.1739; EX1002, ¶95.

While Galda does not provide specifics about its “Equalization + Detection”

³ A distinction between Galda and Brüninghaus lies in how spread (encoded) data symbols are mapped to subcarriers. EX1004, p.1739. Brüninghaus describes “OFDM-TDM with DFT Spreading” in which spread/encoded data symbols are mapped to all subcarriers, while Galda describes “OFDM-FDMA with DFT Spreading” where spread/encoded data symbols are mapped to less than all subcarriers. *Id.*; EX1002, ¶94.

module, Brüninghaus does:

A general block diagram of an OFDM-CDM receiver with linear equalization [8] is depicted in Fig. 4. In case of a Fourier spreading matrix, despreading in the receiver is achieved by an inverse Fast-Fourier matrix, i.e. $[H]^H = [\text{IFFT}]$.

EX1016, p.2330.

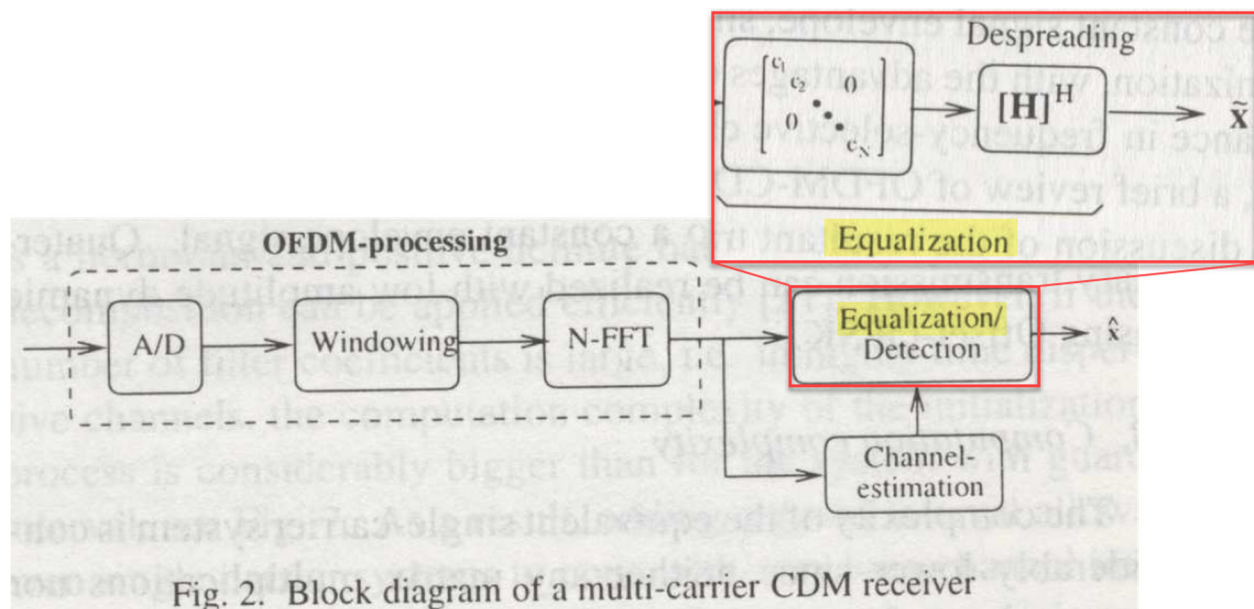


Fig. 2. Block diagram of a multi-carrier CDM receiver

EX1016, pp.2329, 2330 (Figs. 2 & 4 (combined)). As Dr. Bims explains, Brüninghaus uses the Hermitian transpose—i.e., $[H]^H$ —to perform despreading in the receiver. EX1002, ¶¶96-97; EX1016, p.2330. The superscript “ H ” reflects the Hermitian transpose, which is also known as the “conjugate transpose.” See EX1077, 2:2-3 (The Hermitian transpose of a matrix A , denoted by A^H , is the complex conjugate transpose of A .); EX1002, ¶97. It was well known to a POSITA that a

Hermitian transpose is the same as complex conjugate transpose. *See* EX1077, 2:2-3; EX1002, ¶97. In fact, Patent Owner admits this in its US Patent No. 11,700,162 by stating that “[t]he **conjugate transpose is also known as** the adjoint matrix, adugate matrix, Hermitian adjoint, or **Hermitian transpose.**” EX1075, 21:59-61. Thus, Brüninghaus describes that the “*first set of complex-valued codes* (DFT matrix coefficients as in Brüninghaus and Galda) *are complex conjugates of [a] second set of complex-valued codes* (Brüninghaus’s despreading matrix coefficients defined by the Hermitian (i.e., “inverse Fast-Fourier matrix, i.e. $[H]^H = [\text{IFFT}]$ ”). EX1002, ¶97.

It would have been obvious to modify Galda in view of Brüninghaus so as to use a second set of complex codes that are complex conjugates of the codes used for spreading for the reasons explained below, *infra* §VIII(A)(1)(g). Therefore, Galda in view of Brüninghaus renders limitation [1F] obvious. EX1002, ¶98.

g. Motivation to Combine Galda and Brüninghaus and a Reasonable Expectation of Success

A POSITA would have found it obvious to improve Galda’s system with the use of complex conjugates as disclosed in Brüninghaus. EX1002, ¶¶99-105. “The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *KSR Int’l Co. v. Teleflex, Inc.*, 550 U.S. 398 (2007). In view of Brüninghaus’s disclosure of a

benefits of inverting the spreading operation in the receiver using complex conjugates of the spreading codes, it would have been obvious to a POSITA to implement Galda's Base Station to use the **negative** exponential factor " $e^{-j2\pi ij/L}$," for despreading spread received complex-valued symbols, by using the complex conjugate of the **positive** exponential factor exponential factor " $e^{j2\pi ij/L}$," to thereby reverse the DFT spreading operation performed by Galda's mobile terminal. *Id.*; EX1002, ¶99. As Dr. Bims explains, the result of inverting the DFT matrix coefficients applied in Galda using complex conjugate codes at the receiver will be an estimate in the receiver for the data transmitted at each subcarrier frequency, thus allowing the transmitted data bits to be recovered. EX1002, ¶99. As taught in Brüninghaus, applying the complex conjugate of the complex-valued codes (e.g., by applying the Hermitian transpose of the DFT matrix in the receiver) was a known way to recover an estimate of the data bits encoded at the transmitter. EX1016, pp.2329-2330 (Figs. 2 & 4); EX1002, ¶¶99-103.

Therefore, a POSITA would have been motivated to implement the method disclosed in Galda with "*first set of complex-valued codes*" that are "*complex conjugates of the second set of complex-valued codes*" as taught in Brüninghaus. EX1002, ¶¶103-104. Doing so would merely have merely combined Brüninghaus's and Galda's known spreading and despreading codes according to known methods to yield the predictable result of being able to spread and despread data symbols at

transmitters and receivers, respectively. EX1002, ¶104.

A POSITA would have had a reasonable expectation of success in implementing a “*first set of complex-valued codes*” that are “*complex conjugates of the second set of complex-valued codes*,” because it was well known in the art the time to use complex conjugates of codes to reverse the operation performed on data symbols in wireless communications. EX1077, 2:2-3; EX1016, pp.2329-2330; EX1002, ¶105. Indeed, implementing complex-conjugates of the spreading codes used at the transmitter to recover data symbols was a well-understood mathematical technique used to invert operations performed using coefficients of a matrix in communications. EX1002, ¶105.

2. Claim 2: “wherein selecting is responsive to spectrum allocation or is configured to provide for orthogonal frequency division multiple access”

Galda in view of Brüninghaus renders obvious wherein selecting is responsive to spectrum allocation or is configured to provide for orthogonal frequency division multiple access. EX1002, ¶¶106-109.

Galda’s selection both responds to spectrum allocation and provides for OFDM, though one of these is sufficient to render claim 2 unpatentable. Galda explains that the “transmission bandwidth” is subdivided “into a set of orthogonal subcarriers.” EX1004, p.1737. The transmission bandwidth is divided into a total of N_C subcarriers. *Id.*, p.1738 (referring to “ L of the available N_C subcarrier[s]”);

EX1002, ¶107. The selecting of the L subcarriers is *responsive to spectrum allocation*—namely the allocation of a total of N_C subcarriers from which L subcarriers are used by any particular user m . EX1004, p.1738 (“In principle, the set of subcarrier assigned to each user can be composed of any L out of N_C subcarrier that have not been assigned to another user.”); EX1002, ¶107.

Additionally, *selecting is ... configured to provide for OFDMA* because it provides for OFDM-FDMA, a form of OFDMA which allows multiple users m to access the shared bandwidth. EX1004, p.1737 (“The subdivision of the transmission bandwidth into a second of orthogonal subcarriers can additional by exploited by an OFDM-FDMA multiple access scheme” where “different users” use “distinct sets of subcarriers.”); EX1002, ¶108.

Thus, Galda in view of Brüninghaus renders obvious claim 2.

3. Claim 6: “wherein the plurality of subcarriers are contiguous subcarriers or interleaved subcarriers”

Galda in view of Brüninghaus renders obvious wherein the plurality of subcarriers are contiguous subcarriers or interleaved subcarriers. EX1002, ¶¶110-111.

Galda explains that “the set of subcarrier assigned to each user can be composed of any L out of N_C subcarrier that have not been assigned to another user.” EX1004, p.1738. Because Galda teaches that “any L ” subcarriers can be used, a

POSITA would have found it obvious to use either contiguous or interleaved subcarriers because doing so would have merely chosen from among a finite number of predictable solutions with predictable results. EX1002, ¶111. Additionally, Galda discloses selecting “equidistant subcarriers” that are “shifted by m subcarrier in the frequency domain,” Galda discloses that the subcarriers are interleaved subcarriers with one user having one set of subcarriers, and the next user having the next set of subcarriers where every one of the L subcarriers is incremented by 1, thus resulting in interleaved subcarriers. EX1004, p.1738 (Fig. 2); EX1002, ¶111. Galda in view of Brüninghaus thus renders claim 6 obvious.

4. Claim 7: “wherein encoding comprises multiplying a vector or matrix of data symbols with a vector or matrix comprising the first set of complex-valued codes”

Galda in view of Brüninghaus teaches the claimed wherein encoding comprises multiplying a vector or matrix of **data symbols** (Galda’s vector of symbols $\vec{D}^{(m)}$ which includes “ L complex modulation symbols $D_l^{(m)}, l = 0, \dots, L - 1$) with a vector or matrix comprising **the first set of complex-valued codes** (Galda’s “unitary spreading matrix $[C]$ ” that includes “the elements of the discrete Fourier transform matrix”). EX1002, ¶¶112-113. Galda explains that “[t]he spreading operation can be denoted mathematically by the following simple matrix multiplication: $\vec{S}^{(m)} = [C]\vec{D}^{(m)}$.” EX1004, p.1738. Galda’s matrix $[C]$ is a DFT

matrix that includes the first set of complex valued codes defined as “ $C_{i,j}$ ”:

$$C_{i,j} = \left(\frac{1}{\sqrt{L}} \right) \cdot e^{j2\pi i j / L}$$

EX1004, p.1739 (“elements of the discrete Fourier transform”); EX1002, ¶112.

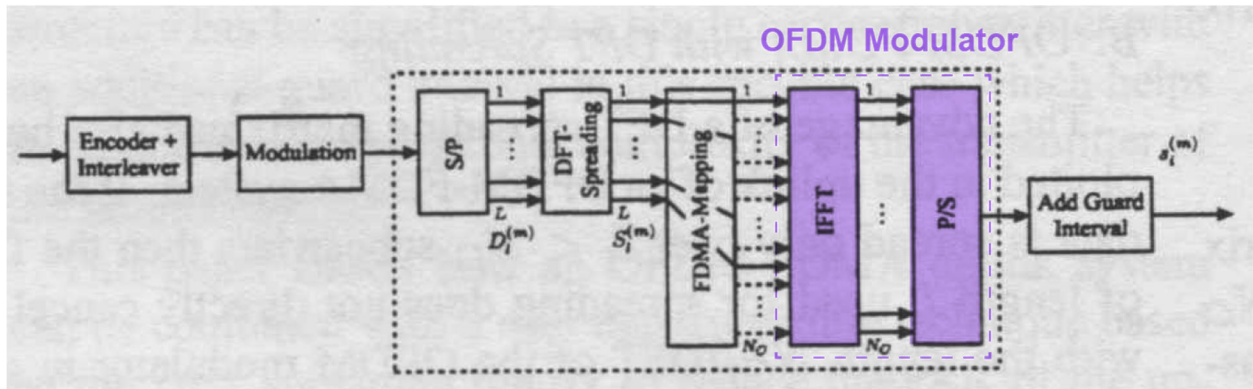
Thus Galda in view of Brüninghaus renders obvious claim 7.

5. Claim 8: “wherein applying comprises modulating the encoded data symbols onto the plurality of subcarriers”

Galda in view of Brüninghaus renders obvious the claimed *wherein applying comprises modulating the encoded data symbols onto the plurality of subcarriers*.

EX1002, ¶¶114-116.

Galda shows an IFFT that is for modulating the encoded (i.e., DFT spread) data symbols onto the plurality of subcarriers (i.e., L subcarriers).



EX1004, p.1740 (Fig. 6(a)). Indeed, this is the common use of an IFFT in OFDM communications as reflected in the '786 patent itself. EX1001, 3:54-58, 41:13-15; EX1002, ¶116.

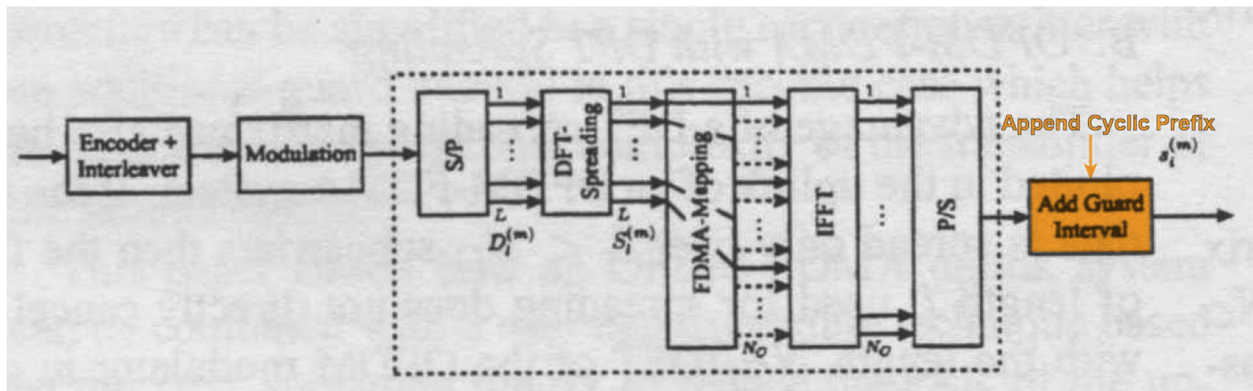
Accordingly, Galda in view of Brüninghaus renders obvious claim 8.

6. Claim 9: “further comprising adding a cyclic prefix to the spread-OFDM signal before transmitting the spread-OFDM signal”

Galda in view of Brüninghaus renders obvious the claimed *adding a cyclic prefix to the spread-OFDM signal before transmitting the spread-OFDM signal*.

EX1002, ¶¶117-119.

Galda’s Fig. 6(a) shows a block “Add Guard Interval,” which Galda explains adds “a guard interval as a cyclic prefix” onto the DFT-spread OFDM signal:



EX1004, p.1740 (Fig. 6(a)); *see also id.*, pp.1737 (noting that interferences can be avoided by “by introducing an additional guard interval into the OFDM symbol”), 1739 (“a guard interval is added in the time domain as a cyclic prefix”); EX1002, ¶¶118-119. As seen here, the cyclic prefix is added after spreading and before transmission. EX1004, p.1740 (Fig. 6(a)).

B. Ground 2: Claims 10-11, 15-18, 19-20, and 24-27 are obvious over Galda in view of Brüninghaus and Dowling

1. Overview of the combination; motivation to combine; expectation of success

Ground 2 relies on Galda in view of Brüninghaus and Dowling and addresses independent claims 10 and 19, and the challenged dependent claims that depend from claims 10 and 19. Claim 10 requires “*a processor*” [10A] and “*a non-transitory computer-readable memory communicatively coupled to the at least one processor, the non-transitory computer-readable memory including a set of instructions stored thereon and executable by the at least one processor*” to perform subsequent steps [10B]. Like claim 10, claim 19 recites a “*computer program product for operating a transmitter in a wireless communication network*” [19Pre]. The challenged dependent claims that depend from claims 10 and 19 are duplicative of the challenged dependent claims that depend from claim 1. EX1002, ¶120.

Galda does not explicitly state whether the disclosed system is implemented in hardware or a combination of hardware and software. EX1002, ¶121. Nevertheless, a POSITA would have understood that Galda would have needed to be implemented using at least one of these technologies. A POSITA would have found it obvious to implement Galda’s transmitter in software stored in memory coupled to a processor such that the software is executed by the processor. EX1002-Bims, ¶¶121-122.

A POSITA would have known that transmitters could be implemented in

hardware or software. EX1002-Bims, ¶122. For example, Dowling discloses an OFDM transmitter and explains that various aspects of its OFDM transmitter including its modulation techniques “may be implemented as software modules which execute on a programmable processor architecture.” EX1042, 3:46-50; *see id.* at 5:66-6:1 (disclosing that the transmitter, receiver, and precoder may be implemented in hardware or software”); 21:62-64 (disclosing that the “present invention” is applicable to FFT based multicarrier modulation and OFDM systems); EX1002-Bims, ¶122. Specifically, Dowling discloses that the “transmitter, receiver, and precoder” can be “constructed using general purpose DSP (digital signal processor) chips, custom VLSI, gate arrays/semicustom VLSI, or a high powered host processor such as a future generation Pentium processor which also runs a computer host operating environment.” EX1042, 6:2-6; EX1002-Bims, ¶122. Dowling further discloses that its transmitter may be implemented as “a computer program which executes on a processor.” EX1042, 19:14-15.

A POSITA would have understood that, in a software implementation, software is stored in memory, and is provided from memory to a processor for execution. EX1002, ¶123. Indeed, as exemplified by numerous prior art references, those skilled in the art were aware of “software radios” that used code in memory and processors to execute that code to provide flexibility in design and updating, as opposed to hardware which was significantly more difficult to upgrade because it is

fixed in silicon. EX1002, ¶123; EX1008 (describing OFDM-CDMA software radio); EX1011, ¶¶[0124]-[0125] (noting that modulation “and other techniques” can be implemented in “hardware, software, or a combination thereof”).

“The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *KSR Int’l Co. v. Teleflex, Inc.*, 550 U.S. 398 (2007). A POSITA would have been motivated to implement Galda’s digital transmitter functions in a software radio (including code in memory and a processor coupled to memory to execute the code) rather than in specialized hardware because doing so would have involved (a) the simple substitution of one known element (a software-based transmitter) for another (hardware implementation of same) to obtain predictable results (the same functionality performed in software rather than hardware), (b) the predictable use of prior art elements (software-based transmitter components) according to their established functions (i.e., performing the same functions taught by Galda), and (c) applying a known technique (software implementation) to a known device (Galda’s transmitter) ready for improvement—e.g., in need of implementation details—to yield predictable results (a transmitter performing Galda’s operations in software). EX1002, ¶124.

A POSITA also would have expected to succeed in making this combination. Galda discloses an OFDM transmitter and defines the various mathematical

operations for each of the components. *Supra* §§VII(A); VIII(A)(1)(a-f); EX1002, ¶125. Implementing these mathematical operations in software would have required only routine knowledge because software is especially well-suited for performing mathematical operations. EX1002, ¶125. Given the number of disclosures indicating that those in the field were aware that various transmitter functions were able to be implemented in either hardware or software—two known alternatives—a POSITA would have reasonably expected in achieving a software implementation using instructions stored on a memory for execution by a processor. EX1002, ¶125.

2. Claim 10

- a. [10Pre] “An apparatus for communication in a wireless communication network that employs a first set of complex-valued codes to encode data symbols to be transmitted, and employs a second set of complex-valued codes to recover transmitted data symbols from a received signal, the apparatus comprising”**

Preambles are not generally limiting. *Arctic Cat*, 919 F.3d at 1327-28. A preamble may be limiting if it “recites essential structure or steps, or if it is necessary to give life, meaning, and vitality to the claim.” *Id.* “When limitations in the body of the claim rely upon and derive antecedent basis from the preamble, then the preamble may act as a necessary component of the claimed invention.” *Pacing Techs.*, 778 F.3d at 1024-25. This preamble corresponds to the preamble of claim 1 except that this preamble is to an apparatus instead of a method. EX1002, ¶126.

Galda in view of Brüninghaus discloses an apparatus that performs the method of claim 1 and as such also renders obvious **[10Pre]**. *Cf. In re Lonardo*, 119 F.3d 960, 968 (Fed. Cir. 1997) (“[T] he claimed structure of the device suggests how it is to be used and that use thus would have been obvious.”). Moreover, as explained above and in further detail below, the combined teachings of Galda in view of Brüninghaus and Dowling render claim 10 obvious. *Supra* §VIII(B)(1); *infra* §§VIII(B)(2)(b-g); EX1002, ¶126.

- b. [10A] & [10B]: “at least one processor; and a non-transitory computer-readable memory communicatively coupled to the at least one processor, the non-transitory computer-readable memory including a set of instructions stored thereon and executable by the at least one processor for”**

Galda in view of Brüninghaus and Dowling discloses and renders obvious *at least one processor [10A] and a non-transitory computer-readable memory communicatively coupled to the at least one processor, the non-transitory computer-readable memory including a set of instructions stored thereon and executable by the at least one processor for [10B]* performing the remaining elements of claim 10. EX1002, ¶¶127-130.

Dowling explains that various aspects of an OFDM transmitter including its modulation techniques “may be implemented as software modules which execute on a programmable processor architecture.” EX1042, 3:46-50; *see id.* at 5:66-6:1

(disclosing that the transmitter, receiver, and precoder may be implemented in hardware or software”); 21:62-64 (disclosing that the “present invention” is applicable to FFT based multicarrier modulation and OFDM systems). In a software implementation, software is stored in memory, and is provided from memory to a processor for execution. EX1002, ¶128. Dowling further discloses that its transmitter may be implemented as “a computer program which executes on a processor.” EX1042, 19:14-15. A POSITA would have understood that “software radios” with code in memory and processors to execute that code to provide flexibility in design and updating and were significantly easier to upgrade than hardware whose implementation would have been fixed in silicon. EX1002, ¶¶129; EX1008 (describing OFDM-CDMA software radio); EX1011, ¶¶[0124]-[0125] (modulation can be implemented in “hardware, software, or a combination thereof”). These references have similar disclosures to the ’786 Patent, which states that various aspects “may be implemented in hardware or special purpose circuits, software,” etc. EX1001, 76:37-43. For the reasons explained above, a POSITA would have found it obvious to implement Galda’s transmitter in software stored on memory for execution by a processor coupled to the memory as recited in claim 10. *Supra* §VIII(B)(1).

Thus, Galda in view of Brüninghaus and Dowling discloses and renders obvious Limitations [10A] and [10B].

c. [10Ci] selecting a plurality of subcarriers to be transmitted

Limitation [10Ci] is the same as Limitation [1A]. *Supra* §VIII(A)(1)(b); EX1002, ¶¶131-132 (providing a claim chart comparing the claim limitations). Limitation [10Ci] is obvious for same reasons as Limitation [1A]. *Id.*

d. [10Cii] encoding the data symbols with the first set of complex-valued codes to produce encoded data symbols

Limitation [10Cii] is the same as Limitation [1B]. *Supra* § VIII(A)(1)(c); EX1002, ¶¶133-134 (providing a claim chart comparing the claim limitations). Accordingly, Limitation [10Cii] is obvious for same reasons as Limitation [1B]. *Id.*

e. [10Ciii] applying the encoded data symbols to the plurality of subcarriers to produce a spread-Orthogonal Frequency Division Multiplexing (OFDM) signal

Limitation [10Ciii] is the same as Limitation [1C]. *Supra* § VIII(A)(1)(d). EX1002, ¶¶135-136 (providing a claim chart comparing the claim limitations). Accordingly, Limitation [10Ciii] is obvious for same reasons as Limitation [1C]. *Id.*

f. [10Civ] transmitting the spread-OFDM signal

Limitation [10Civ] is the same as Limitation [1D]. *Supra* § VIII(A)(1)(e); EX1002, ¶¶137-138 (providing a claim chart comparing the claim limitations). Accordingly, Limitation [10Civ] is obvious for same reasons as Limitation [1D]. *Id.*

g. [10Cv] wherein the first set of complex-valued codes are complex conjugates of the second set of complex-

valued codes.

Limitation [10Cv] is the same as Limitation [1E]. *Supra* § VIII(A)(1)(f); EX1002, ¶139-140 (providing a claim chart comparing the claim limitations). Accordingly, Limitation [10Cv] is obvious for same reasons as Limitation [1E]. *Id.*

3. Claim 19

Claim 19 recites a “*computer program product*” with the same limitations as the apparatus limitations in claim 10. EX1002, ¶141 (providing a claim chart comparing claim 19 and claim 10). Specifically, the “*selecting*,” “*encoding*,” “*applying*,” and “*transmitting*” steps recited in claim 10 are identical to the instructions for “*selecting*,” “*encoding*,” “*applying*,” and “*transmitting*” recited in claim 19. EX1002, ¶142. Furthermore, both claim 19 and claim 10 conclude with the same wherein clause, as follows: “*wherein the first set of complex-valued codes are complex conjugates of the second set of complex-valued codes.*” EX1002, ¶142.

As noted above in Section § VIII(B)(2)(b), Dowling further discloses that its transmitter may be implemented as “**a computer program which executes on a processor.**” EX1042, 19:14-15; EX1002, ¶143. Furthermore, as established above in §VIII(B)(1), it would have been obvious to a POSITA, in a software implementation, software is stored in memory, and is provided from memory to a processor for execution. EX1002, ¶143. Accordingly, just as the processor and memory recited in claim 10 would have been obvious over Galda in view of

Brüninghaus and Dowling, the “*computer program product*” recited in claim 19 is rendered obvious by Galda in view of Brüninghaus and Dowling. Thus, claim 19 is obvious over Galda in view of Brüninghaus and Dowling for the same reasons as set forth for claim 10 above. §VIII(B)(2); EX1002-Bims, ¶143.

4. Claims 11 and 20

Claims 11 and 20 are substantially the same as claim 2. *Supra* §VIII(A)(2); EX1002, ¶¶144-145 (providing a claim chart comparing the claims). Accordingly, claims 11 and 20 are obvious for same reasons as claim 2. *Id.*

5. Claims 15 and 24

Claims 15 and 24 are substantially the same as claim 6. *Supra* §VIII(A)(3); EX1002, ¶¶146-147 (providing a claim chart comparing the claims). Accordingly, claims 15 and 24 are obvious for same reasons as claim 6. *Id.*

6. Claims 16 and 25

Claims 16 and 25 are substantially the same as claim 7. *Supra* § VIII(A)(4); EX1002, ¶148-149 (providing a claim chart comparing the claims). Accordingly, claims 16 and 25 are obvious for same reasons as claim 7. *Id.*

7. Claims 17 and 26

Claims 17 and 26 are substantially the same as claim 8. *Supra* § VIII(A)(5); EX1002, ¶¶150-151 (providing a claim chart comparing the claim limitations). Accordingly, claims 17 and 26 are obvious for same reasons as claim 8. *Id.*

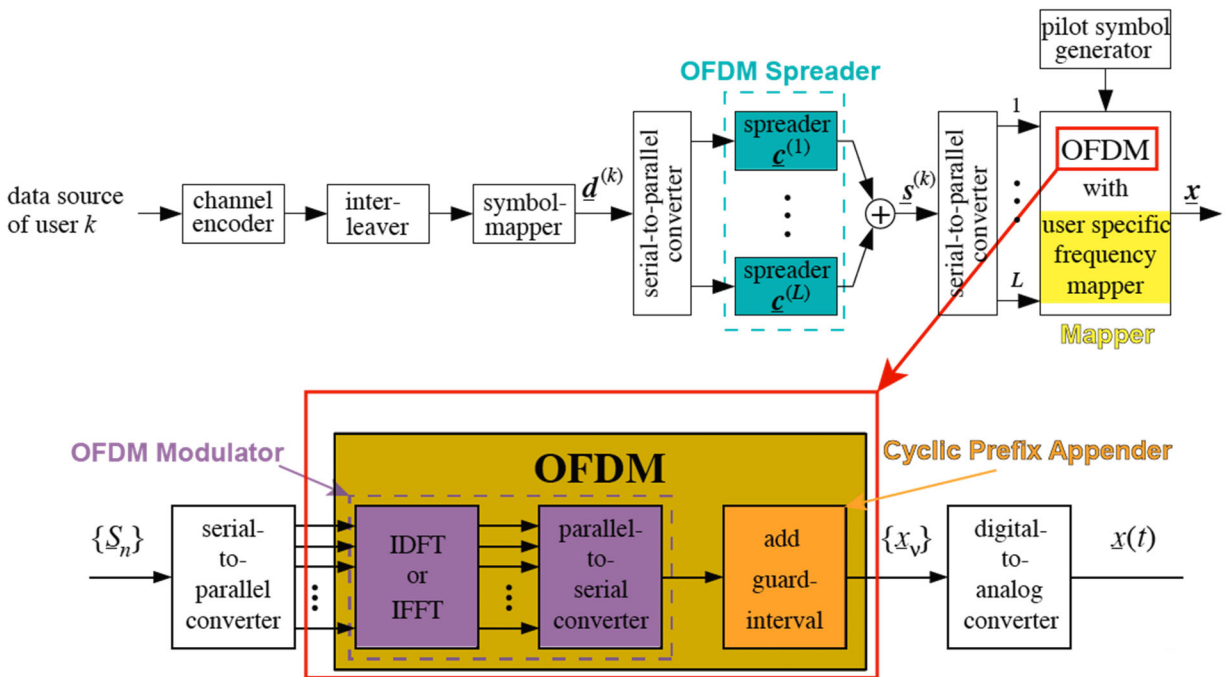
8. Claims 18 and 27

Claims 18 and 27 are substantially similar to claim 9. *Supra* § VIII(A)(6); EX1002, ¶¶152-153 (providing a claim chart comparing the claims). Accordingly, claims 18 and 27 are obvious for same reasons as claim 9. *Id.*

C. Ground 3: Claims 1, 2, and 6-9 Are Obvious Over Kaiser in View of Bury

1. Overview of the Motivation to Combine Kaiser in View of Bury and the Reasonable Expectation of Success

Kaiser expressly discloses most elements of the Challenged Claims. EX1002, ¶154. Kaiser describes an “SS-MC-MA transmitter” (e.g., Figure B.2) in which data symbols ($\underline{d}^{(k)}$) are encoded (spread) with Walsh-Hadamard codes (“OFDM Spreader,” below) and an element that applies the spread data symbols to L selected subcarriers to produce a spread OFDM signal ($\underline{x}$), and a block for adding a cyclic prefix (guard interval):

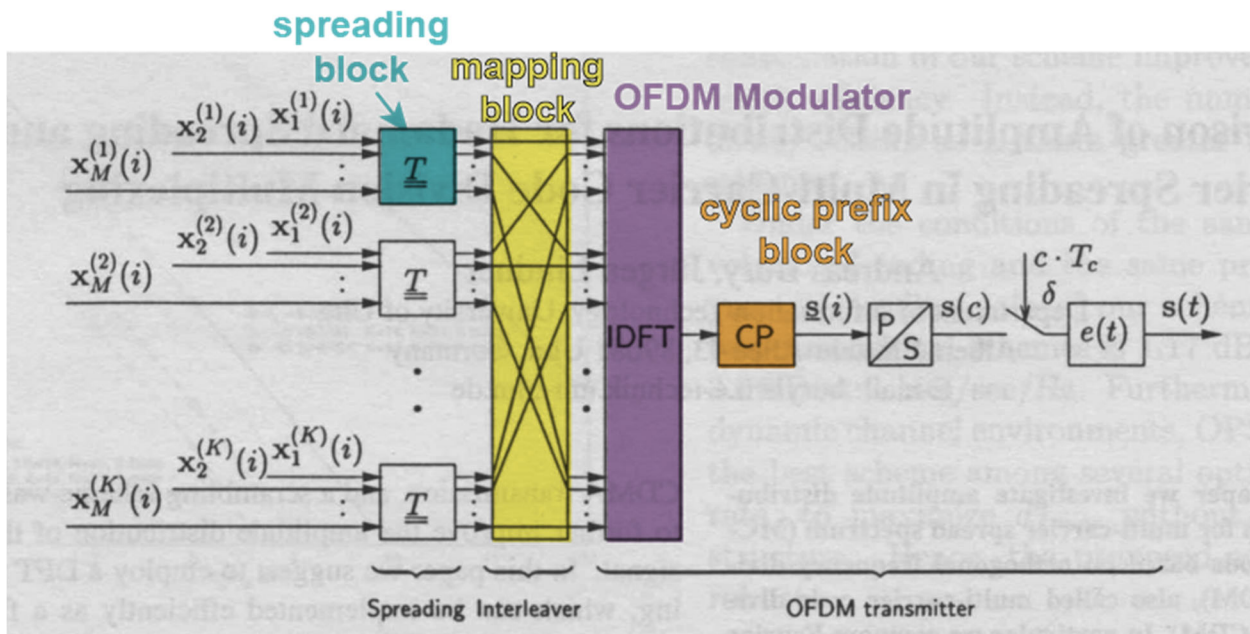


EX1005 (Fig. B.2 & Fig. 3.2); EX1002, ¶154. “OFDM with guard interval is applied in SS-MC-MA systems”—see Kaiser Figure B.2—“in the same way as in MC-CDMA systems, cf. Section 3.1.1.” EX1005, p.133. Thus, a POSITA would have understood that Figure B.2’s “OFDM” has the functional blocks shown in §3.1.1, Figure 3.2. EX1002, ¶155.

Kaiser’s OFDM transmitter spreads data symbols with Walsh-Hadamard spreading and not the claimed DFT spreading. EX1005, p.135 (“[A] block of ... data symbols is ... spread with orthogonal Walsh Hadamard codes ...”); *id.*, p.134 (Table B.1, “spreading code”). Kaiser, however, does not disclose using complex-valued spreading codes. EX1002, ¶156.

Bury describes a multi-carrier code division multiplexing (MC-CDM)

transmitter that is “valid for both[] MC-CDMA and MC-FDMA” (called “MC-SS-MA” by Kaiser). EX1007, pp.857, 858; EX1002, ¶157. Bury describes an OFDM transmitter in Figure 1 that, like Kaiser, includes a spreading block, a mapping block (interleaver), a modulator, and a block for adding a cyclic prefix:



EX1007, p.858 (Fig. 1); EX1002, ¶157.

“Walsh-Hadamard spreading” is “commonly used” in MC-CDM systems. EX1007, p.857; EX1002, ¶158. This is true of Kaiser. EX1002, ¶158. Bury evaluated whether there were better spreading codes. *Id.* Bury concluded that using “Fourier spreading” using a “discrete Fourier transform (DFT) operation” materially improved PAPR performance over Walsh-Hadamard codes. *Id.* For instance, using Kaiser’s MC-SS-MA (i.e., Bury’s MC-FDMA) technique, “the PAPR remains nearly constant at a low level for all spreading factors.” *Id.*, p.860. Thus, “in the

uplink Fourier spreading outperforms Hadamard spreading in most cases.” *Id.* “For both up- and down-link Fourier spreading delivers a lower or equal PAPR. This superiority increases significantly for larger spreading factors. In the uplink, MC-FDMA (Kaiser’s MC-SS-MA) delivers lower PAPRs than MC-CDMA.” *Id.* Bury thus concludes Fourier spreading is “the best choice” combined with MC-FDMA in the uplink. *Id.*; EX1002, ¶158.

Based on these teachings, a POSITA would have been motivated to use Bury’s DFT-spreading (Fourier spreading “implemented by” a DFT, EX1007, p.857) instead of Kaiser’s Walsh-Hadamard codes in Kaiser’s spreader for uplink OFDM transmissions. EX1002, ¶159. Not only are Kaiser and Bury discussing the same types of OFDM transmission systems (MC-FDMA (Bury) or MC-SS-MA (Kaiser), EX1007, p.857), but Bury concluded that DFT-spreading was “the best choice” for uplink communications. EX1002, ¶159. Bury thus provides an explicit motivation to use DFT spreading codes (DFT matrix) for spreading instead of Kaiser’s Walsh-Hadamard codes. EX1002, ¶159. “The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *KSR Int’l Co. v. Teleflex, Inc.*, 550 U.S. 398 (2007).

Combining Kaiser and Bury would have merely applied Bury’s known Fourier spreading techniques to improve Kaiser’s MC-SS-MA uplink transmitter with Bury’s Fourier spreading codes instead of Kaiser’s Walsh-Hadamard codes

thereby improving Kaiser's MC-SS-MA transmitter in the same way that it improved Bury's MC-FDMA transmitter. EX1002, ¶¶160-161.

POSITA would have reasonably expected to succeed in using Bury's spreading codes in Kaiser's system because Bury describes using such spreading codes in the context of a system like Kaiser's and a POSITA would have understood that implementing DFT spreading codes would have merely required the undergraduate-level mathematical techniques (i.e., a DFT) to spread data symbols. EX1002, ¶162.

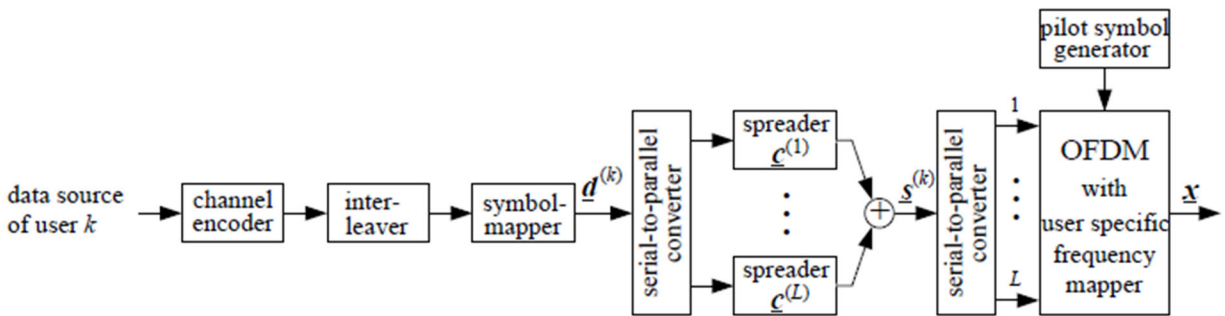
2. Claim 1

a. [1Pre] A method for communicating ...

As a general rule preambles are not limiting. *Arctic Cat*, 919 F.3d at 1327-28. For this Petition, however, assuming that claim 1's preamble is limiting, Kaiser in view of Bury renders obvious the claimed *method of communication in a wireless communication network that employs a first set of complex-valued codes* (Kaiser's Walsh-Hadamard codes replaced with Bury's complex-valued DFT coefficients) *to encode data symbols to be transmitted* (to encode Kaiser's "complex valued data symbols $\underline{d}_l^{(k)}, l = 1 \dots L$ ") *and employs a second set of complex-valued codes* (complex-conjugate of the spreading codes as taught by Kaiser and complex-valued codes as taught by Bury) *to recover transmitted data symbols from a received signal* (to recover "complex valued data symbols $\underline{d}_l^{(k)}, l = 1 \dots L$ " at the receiver).

EX1002, ¶163.

Kaiser illustrates a “SS-MC-MA transmitter of the k th user for the uplink” as shown below:

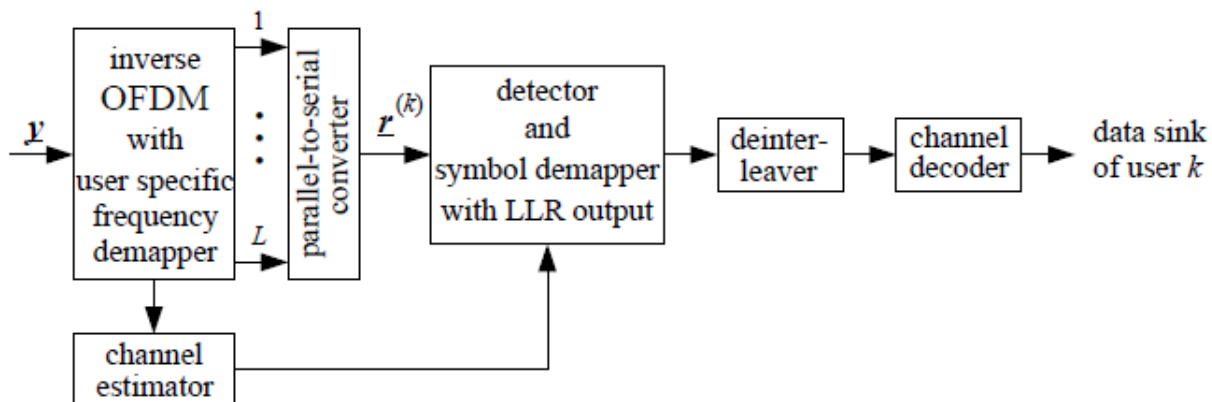


EX1005, p.132. This transmitter performs *a method* when it is operated. EX1002, ¶¶164-165. Specifically, it performs a method for *communicating in a wireless communication network* as is evident from Kaiser’s reference to “an SS-MC-MA mobile radio system,” EX1005, pp.130, 133; a POSITA would have understood that mobile radio systems transmit over wireless channels on the uplink, EX1002, ¶165.

Kaiser’s transmitter *employs a first set of codes to encode data symbols to be transmitted*. Specifically, Kaiser describes encoding “complex-valued data symbols $\underline{d}_l^{(k)}, l = 1 \dots L$ ” by multiplying them “with another orthogonal spreading code of length L ” where the spreading codes are defined by a matrix ($\underline{C}$) that “is the same for all users.” EX1005, p.132 (describing “ $L \times L$ matrix” $\underline{C}$ that “represents the L different spreading codes $\underline{c}_l$ ”). The spreading codes are Walsh-Hadamard codes. EX1005, pp.134, 135. But, as explained above, it would have been obvious to

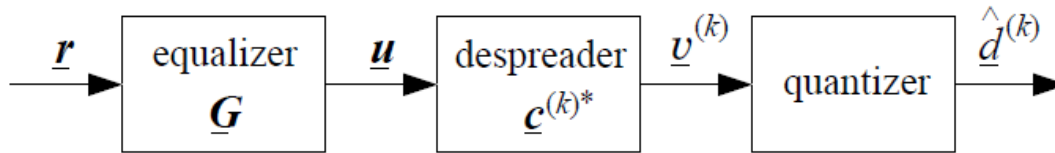
replace Kaiser's Walsh-Hadamard codes with Bury's DFT spreading codes. EX1007, p.857 ("Fourier spreading ... implemented by a discrete Fourier transform (DFT) operation"). *Supra* § VIII(C)(1); EX1002, ¶166. This renders obvious the claimed *first set of complex codes* because Fourier coefficients are complex-valued. EX1002, ¶166.

Kaiser's receiver *employs a second set of codes to recover transmitted data symbols from a received signal*. Kaiser's "SS-MC-MA receiver for the k th user" is depicted below:



EX1005, p.133; EX1002, ¶167.

Kaiser's receiver can use "any of the SD or MD data detection techniques presented for MC-CDMA systems in Section 3.3 ... for the detection of data of a single user per subsystem in SS-MC-MA systems." *Id.* "Single-User Detection" or "SD" uses an equalizer, despreader, and quantizer to detect "the user signal of interest":



EX1005, p.49; EX1002, ¶168. Despreader accepts “[t]he complex-valued output $\underline{u}$ of the equalizer” and correlates “it with the conjugate complex user specific spreading code $\underline{c}^{(k)*}$.” EX1005, p.49; EX1002, ¶169. Thus, Kaiser describes *a second set of codes to recover transmitted data symbols from a received signal* where $\underline{r}$ is the received signal and $\underline{c}^{(k)*}$ is the *second set of codes* (where user specific codes is defined as a set of codes $\underline{c}^{(k)} = (\underline{c}_1^{(k)}, \underline{c}_2^{(k)}, \dots, \underline{c}_L^{(k)})^T$, EX1005, p.39 (equation 3.25); EX1002, ¶169. While the second set of codes is not *complex-valued*, it would have been obvious to use Bury’s *complex-valued* codes for the reasons explained above. *Supra* §VIII(C)(1); EX1002, ¶169.

b. [1A]: selecting subcarriers

Kaiser in view of Bury renders obvious *selecting a plurality of subcarriers to be transmitted*. EX1002, ¶¶170-172.

Kaiser describes an SS-MC-MA system that “is an FDMA scheme on [the] subcarrier level” and in which “each subcarrier is exclusively used by one user.” EX1005, p.131. Kaiser’s transmitter “performs a user-specific frequency mapping ... such that subsequent components of $\underline{s}^{(k)}$ are interleaved and mapped to

subcarriers with maximum distance.” EX1005, p.132; EX1002, ¶171. “The subcarriers of the different systems are chosen such that each subsystem exploits the whole transmission bandwidth.” *Id.* In Kaiser’s system there are 256 subcarriers and each user is allocated eight of them. EX1005, pp.133, 134. Thus, Kaiser describes *selecting a plurality of L subcarriers per user to be transmitted on the uplink.* EX1002, ¶171; EX1005, p.132 (“The user specific frequency mapping assigns each subsystem, and, hence, each user exclusively its L subcarriers.”).

Accordingly, Kaiser in view of Bury renders obvious Limitation [1A].

c. [1B]: encoding data symbols

Kaiser in view of Bury renders obvious *encoding the data symbols* (Kaiser’s “complex-valued data symbols $\underline{d}_l^{(k)}, l = 1 \dots L$ ”) *with the first set of complex-valued codes* (Kaiser’s spreading codes as modified by Bury to be DFT coefficients) *to produce encoded data symbols* (spread data symbols $\underline{s}^{(k)} = (\underline{s}_1^{(k)}, \underline{s}_2^{(k)} \dots \underline{s}_L^{(k)})$). EX1002, ¶¶173-175.

Kaiser encodes *data symbols* which Kaiser describes as being “complex-valued data symbols $\underline{d}_l^{(k)}, l = 1 \dots L$ ” using a *first set of codes*, namely, “spreading codes $\underline{c}_l, l = 1, \dots, L$ ” from matrix $\underline{C}$. EX1005, p.132; EX1002, ¶174. Kaiser describes the encoding as being a multiplication of matrix $\underline{C}$ by vector $\underline{d}^{(k)}$: $\underline{s}^{(k)} = \underline{C} \underline{d}^{(k)}$. EX1005, p.132. Kaiser’s spreading codes are not *complex-valued* but Bury teaches

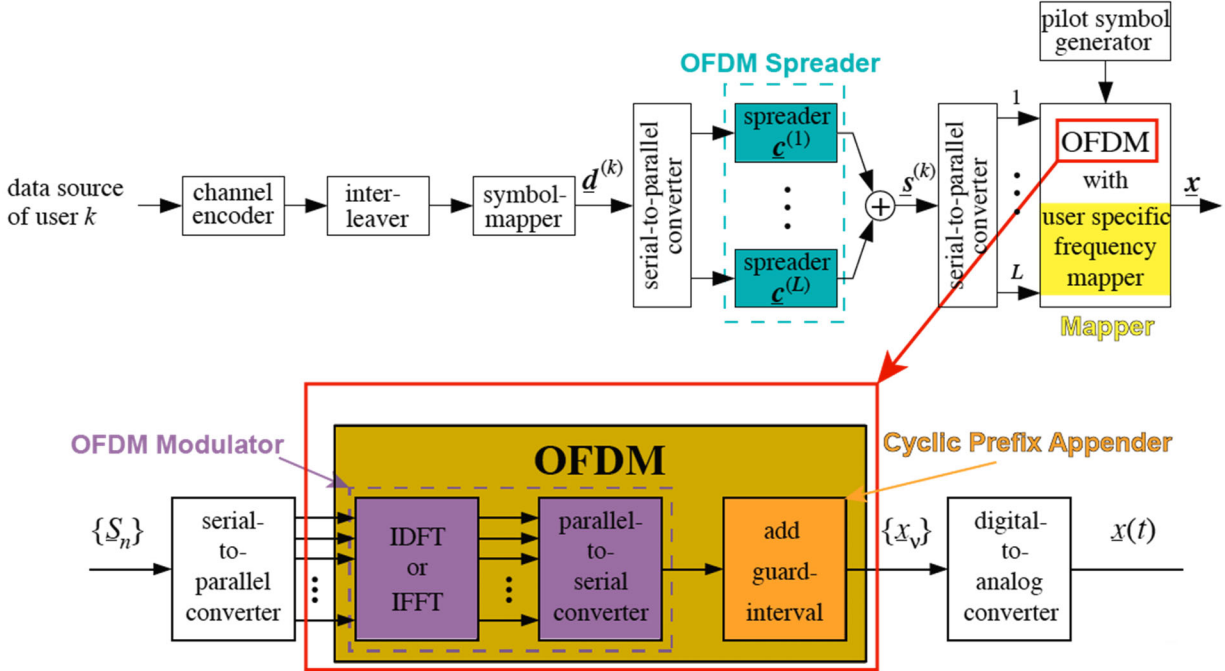
“Fourier spreading” which use complex-valued Fourier coefficients. EX1007, p.857; EX1002, ¶174; EX1047, p.4 (Patent Owner admitting that “portion of the DFT $e^{-j\frac{2\pi ik}{M_{SC}^{PUSCH}}}$... correspond to complex-valued spreading codes”). It would have been obvious to modify Kaiser to use Bury’s *complex-valued codes* instead of Kaiser’s Walsh-Hadamard codes for the reasons explained above. *Supra* § VIII(C)(1). The result would be to produce Kaiser’s *encoded data symbols* $\underline{s}^{(k)} = (\underline{s}_1^{(k)}, \underline{s}_2^{(k)} \dots \underline{s}_L^{(k)})$, using DFT spreading. EX1002, ¶174.

Accordingly, Kaiser in view of Bury renders obvious Limitation [1B].

d. [1C]: applying encoded symbols to subcarriers

Kaiser in view of Bury renders obvious *applying the encoded data symbols* $(\underline{s}^{(k)} = (\underline{s}_1^{(k)}, \underline{s}_2^{(k)} \dots \underline{s}_L^{(k)}))$ *to the plurality of subcarriers* (to L subcarriers) *to produce a spread-Orthogonal Frequency Division Multiplexing (OFDM) signal* (e.g., transmission signal “ $\underline{x}$ ” in Fig. B.2). EX1002, ¶¶176-180.

Kaiser applies *the encoded data symbols* $(\underline{s}^{(k)} = (\underline{s}_1^{(k)}, \underline{s}_2^{(k)} \dots \underline{s}_L^{(k)}))$ to the subcarriers using “user specific frequency mapper”:



EX1005, pp.34, 132 (Fig. B.2 & Fig. 3.2). This “user specific frequency mapper” “assigns each subsystem and, hence, each user exclusively its L subcarriers, avoiding MAI.” EX1005, p.132. Kaiser also discloses a specific example in which its mapper maps spread symbols of each user’s data signals to $L=8$ subcarriers (out of an available $N_C=256$ total subcarriers). EX1005, pp.134-135 (describing “8 subcarriers used by the k th user”).

The encoded data is applied to the L subcarriers and then OFDM modulated using “IDFT or IFFT” block. EX1005, p.32 (“MC modulation can be implemented in the discrete domain using an IDFT, or a more computationally efficient IFFT....”). This produces a *spread-Orthogonal Frequency Division Multiplexing (OFDM) signal “ $\underline{x}$ ”* in Fig. B.2, which has been spread using Bury’s DFT

coefficients (“Fourier spreading”) instead of Kaiser’s Walsh-Hadamard spreading codes for the reasons discussed above. *Supra* § VIII(C)(1); EX1002, ¶¶176-180.

Thus, Kaiser in view of Bury renders obvious Limitation [1C].

e. [1D]: transmitting the spread OFDM signal

Kaiser in view of Bury renders obvious *transmitting the spread-OFDM signal*. EX1002, ¶¶181-183.

Kaiser describes an “SS-MC-MA transmitter” for the uplink (i.e., from a mobile device to a base station). EX1005, pp.131-132; EX1002, ¶182. Kaiser’s transmitter is used in the context of a “SS-MC-MA mobile radio system.” EX1005, p.130. A POSITA would have understood that transmitters transmit signals, and, in the case of Kaiser, a spread-OFDM signal (spread using Walsh-Hadamard codes). EX1002, ¶182. In the case of the combined Kaiser-Bury system, the spread-OFDM signal is a DFT spread OFDM signal. *Id.*, ¶182. Kaiser recommends using SS-MC-MA in the uplink to achieve “high bandwidth efficiency and great flexibility.” EX1005, p.137. Therefore, a POSITA would have understood that Kaiser describes *transmitting a spread-OFDM signal*, and in the context of Kaiser in view of Bury, *transmitting a DFT spread-OFDM signal*. EX1002, ¶182.

Thus, Kaiser in view of Bury renders obvious Limitation [1D].

f. [1E]: complex conjugates

Kaiser in view of Bury renders obvious *wherein the first set of complex-valued*

codes are complex conjugates of the second set of complex-valued codes. EX1002, ¶¶184-186.

Kaiser complex conjugate codes in the “despreader” found in its SS-MC-MA receiver. EX1005, p.49. Reference is made to the discussion of the preamble [1Pre]. *Supra* §VIII(C)(a). As explained there, Kaiser’s despreader accepts “[t]he complex-valued output $\underline{u}$ of the equalizer” and correlates “it with the conjugate complex user specific spreading code $\underline{c}^{(k)*}$.” *Id.* Thus, while Kaiser performs spreading with “spreading codes $\underline{c}_l$, $l=1, \dots, L$,” represented in matrix $\underline{C}$, EX1005, p.132, Kaiser performs despreading in receiver using the complex conjugate of the codes used to perform spreading. EX1005, p.39 (describing user specific spreading codes as a set of codes $\underline{c}^{(k)} = (\underline{c}_1^{(k)}, \underline{c}_2^{(k)}, \dots, \underline{c}_L^{(k)})^T$, EX1005, p.39 (equation 3.25); EX1002, ¶185. Specifically, Kaiser discloses that **“[t]he complex-valued output $\underline{u}$ of the equalizer is despread by correlating it with the conjugate complex user specific spreading code $\underline{c}^{(k)*}$ cf. (3.25).** The complex-valued soft decided value at the output of the despreader is $\underline{v}^{(k)} = \underline{c}^{(k)*} \underline{u}^T$ ” which indicates that complex conjugate codes $\underline{c}_1^{(k)*}, \underline{c}_2^{(k)*}, \dots, \underline{c}_L^{(k)*}$ are applied to the “sequence at the output of the equalizer” $\underline{u} = (\underline{u}_1, \underline{u}_2 \dots \underline{u}_L)^T$. EX1005, p.49; EX1002, ¶185. This means that the *first set of codes are complex conjugates of the second set of codes.* EX1002, ¶185. And, for the reasons explained above it would have been obvious to use *complex-valued codes* in

the context of Kaiser based on Bury. *Supra* §VIII(C)(1).

Therefore, Kaiser in view of Bury renders Limitation [1E] obvious.

3. Claim 2

Kaiser in view of Bury renders obvious *wherein selecting is responsive to spectrum allocation or is configured to provide for orthogonal frequency division multiple access*. EX1002, ¶187-189.

Kaiser's subcarriers are "chosen such that each subsystem exploits the whole transmission bandwidth" from among the 256 total subcarriers where each user is allocated eight subcarriers. EX1005, pp.133, 134. Thus, Kaiser's *selecting is configured to provide for orthogonal frequency division multiple access* by allowing user data for user *k* to be spread across eight subcarriers and user data for another user *k'* to be spread across a different group of eight subcarriers. EX1002, ¶189; EX1005, p.132 ("The user specific frequency mapping assigns each subsystem, and, hence, each user exclusively its *L* subcarriers."); *see also* EX1005, p.131 ("SS-MC-MA is an FDMA [frequency division multiple access] on subcarrier level").

Therefore, Kaiser in view of Bury renders obvious claim 2.

4. Claim 6

Kaiser in view of Bury renders obvious *wherein the plurality of subcarriers are contiguous subcarriers or interleaved subcarriers*. EX1002, ¶190-193.

Kaiser's subcarriers are *interleaved subcarriers*. Kaiser explains:

Comparable to the frequency interleaving in MC-CDMA systems, the SS-MC-MA transmitter performs a user specific frequency mapping [KaF97b] such that subsequent components of $\underline{s}^{(k)}$ are interleaved and mapped to subcarriers with maximum distance. The subcarriers of the different subsystems are chosen such that each subsystem exploits the whole transmission bandwidth. The user specific frequency mapping assigns each subsystem and, hence, each user exclusively its L subcarriers, avoiding MAI.

EX1005, pp.130-31. This discloses *interleaved subcarriers* that are separated such that they occupy the “whole transmission bandwidth” for each user. EX1002, ¶192.

Therefore, Kaiser in view of Bury renders obvious claim 6.

5. Claim 7

Kaiser in view of Bury renders obvious *wherein encoding comprises multiplying a vector or matrix of data symbols ($\underline{d}^{(k)} = (\underline{d}_1^{(k)}, \underline{d}_2^{(k)}, \dots, \underline{d}_L^{(k)})^T$) with a vector or matrix comprising the first set of complex-valued codes (Kaiser’s code matrix $\underline{C}$ with “spreading codes $\underline{c}_l, l = 1, \dots, L$, used by user k ” as modified to include Bury’s DFT spreading codes/coefficients)*. EX1002, ¶¶194-198.

Kaiser’s encoding (i.e., spreading) includes *multiplying a vector of data symbols with a matrix comprising the first set of codes*, as explained below:

In SS-MC-MA systems ... [t]he vector

$$\underline{d}^{(k)} = \left(\underline{d}_1^{(k)}, \underline{d}_2^{(k)}, \dots, \underline{d}_L^{(k)} \right)^T \quad (B.1)$$

represents one block of L parallel converted data symbols of the k th user. Each of the L data symbols is multiplied with another orthogonal spreading code of length L . The $L \times L$ matrix

$$\underline{C} = \begin{pmatrix} \underline{c}_1 & \underline{c}_2 & \dots & \underline{c}_L \end{pmatrix} = \begin{pmatrix} \underline{C}_{1,1} & \underline{C}_{2,1} & \dots & \underline{C}_{L,1} \\ \underline{C}_{1,2} & \underline{C}_{2,2} & \dots & \underline{C}_{L,2} \\ \vdots & \vdots & \dots & \vdots \\ \underline{C}_{1,L} & \underline{C}_{2,L} & \dots & \underline{C}_{L,L} \end{pmatrix} \quad (B.2)$$

represents the L different spreading codes $\underline{c}_l, l = 1, \dots, L$, used by user k . The matrix $\underline{C}$ is the same for all users. The modulated spreading codes are data symbol and, thus, chip synchronously added, resulting in the transmission vector

$$\underline{s}^{(k)} = \underline{C} \underline{d}^{(k)} = \left(\underline{s}_1^{(k)}, \underline{s}_2^{(k)}, \dots, \underline{s}_L^{(k)} \right)^T \quad (B.3)$$

consisting of L components.

EX1005, pp.131-32; *see id.*, pp.130-31, 133-35. Here, the expression $\underline{s}^{(k)} = \underline{C} \underline{d}^{(k)}$ shows a vector ($\underline{d}^{(k)}$) multiplied by a matrix of spreading codes ($\underline{C}$). EX1002, ¶197. And, it would have been obvious to use *complex-valued* codes instead of Kaiser's Walsh-Hadamard codes for the reasons explained above. *Supra* § VIII(C)(1); EX1002, ¶197.

Therefore, Kaiser in view of Bury renders obvious claim 7.

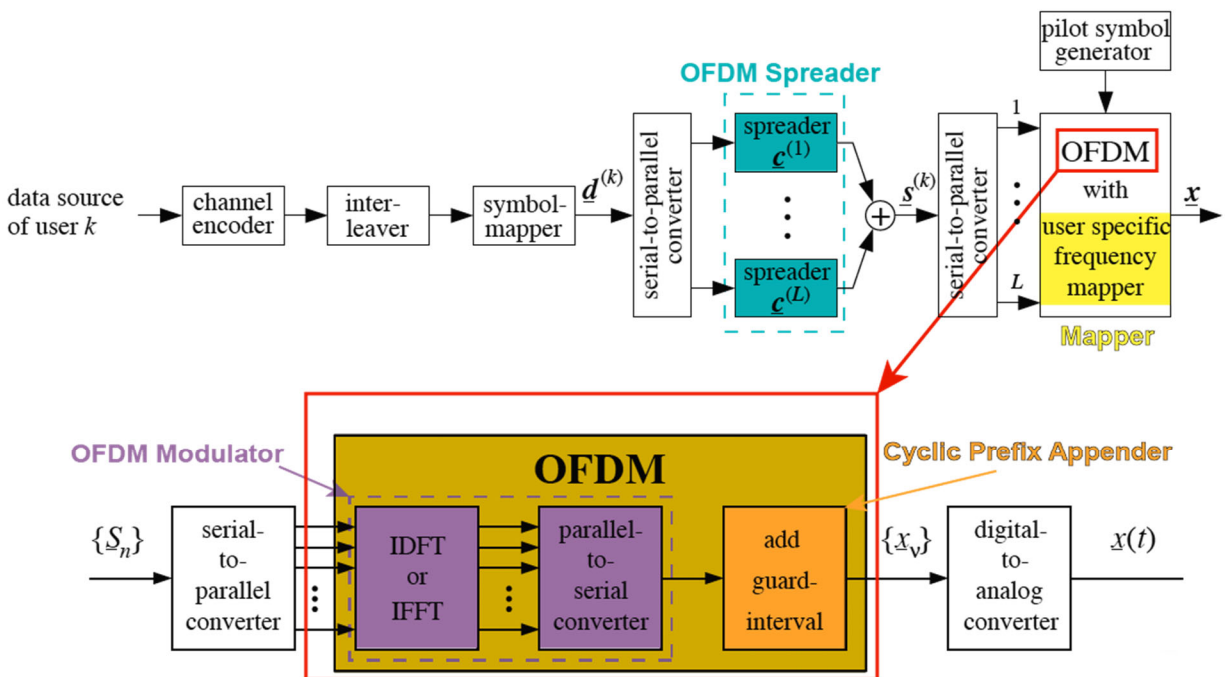
6. Claim 8

Kaiser in view of Bury renders obvious the claimed *wherein applying*

comprises modulating the encoded data symbols onto the plurality of subcarriers.

EX1002, ¶199-201.

Kaiser illustrates a block that includes “OFDM with user specific frequency mapping.”

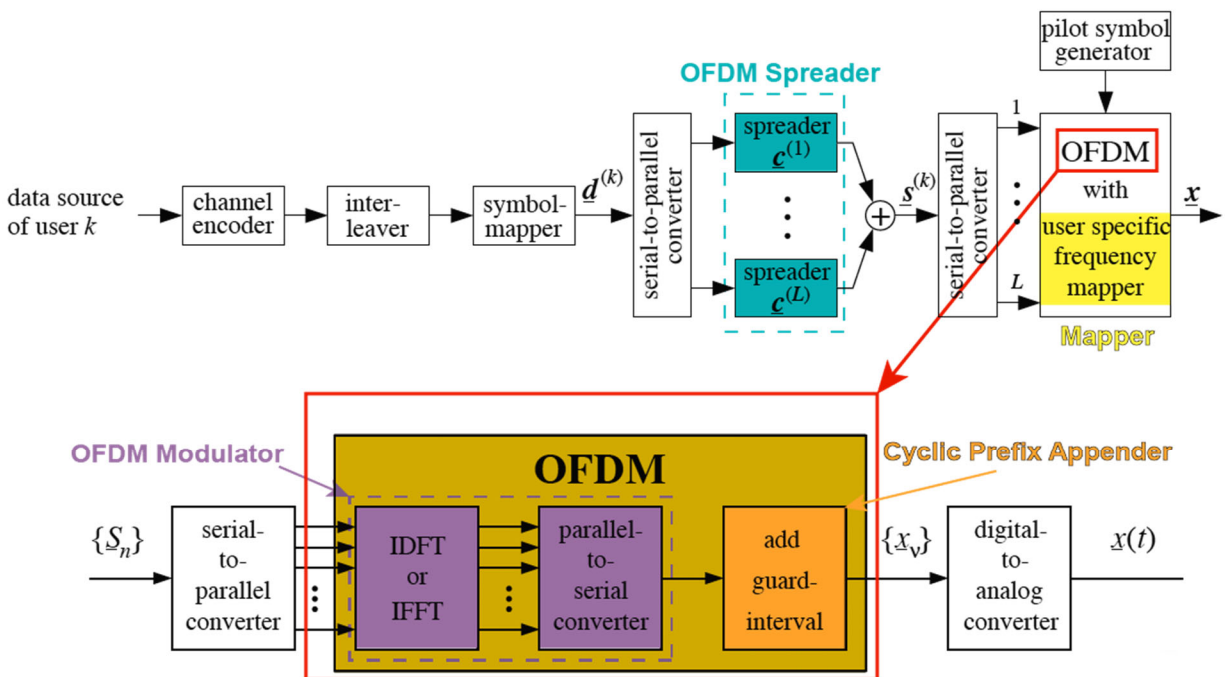


EX1005, p.132. This mapping applies encoded data to L subcarriers and then OFDM modulates that data using “IDFT or IFFT” block. EX1005, p.32 (“MC modulation can be implemented in the discrete domain using an IDFT, or a more computationally efficient IFFT...”). Thus Kaiser teaches *applying comprises modulating the encoded data symbols $s^{(k)}$ onto the plurality of subcarriers*—i.e., (L) subcarriers. EX1002, ¶¶200-201.

7. Claim 9

Kaiser in view of Bury renders obvious the claimed *adding a cyclic prefix to the spread-OFDM signal before transmitting the spread-OFDM signal*. EX1002, ¶¶202-205.

Kaiser shows a block called “add guard interval” as part of the OFDM block:



EX1005, pp.34, 132 (Fig. B.2 & Fig. 3.2); EX1002, ¶203. Kaiser explains “[t]he guard interval is a cyclic prefix added to each OFDM symbol which is obtained by extending the duration of the OFDM symbol....” EX1005, p.33. Bury also contemplates adding a “cyclic extension” in the transmitter. EX1007, p.859; EX1002, ¶204.

Therefore, Kaiser in view of Bury renders obvious claim 9.

**D. Ground 4: Claims 10-11, 15-18, 19-20, and 24-27 Are Obvious
Over Kaiser in View of Bury and Dowling**

**1. Overview of the Motivation to Combine Kaiser in View of
Bury and Dowling and the Reasonable Expectation of
Success**

Ground 4 relies on Kaiser in view of Bury and Dowling and addresses independent claims 10 and 19, and the challenged dependent claims that depend from claims 10 and 19. Claim 10 requires “*a processor*” [10A] and “*a non-transitory computer-readable memory communicatively coupled to the at least one processor, the non-transitory computer-readable memory including a set of instructions stored thereon and executable by the at least one processor*” to perform subsequent steps [10B]. Similar to claim 10, claim 19 recites a “*computer program product for operating a transmitter in a wireless communication network.*” The challenged dependent claims that depend from claims 10 and 19 are duplicative of the challenged dependent claims that depend from claim 1. EX1002, ¶206.

Kaiser does not explicitly state whether the disclosed system is implemented in hardware or a combination of hardware and software. EX1002, ¶207. Nevertheless, a POSITA would have understood that Kaiser would have needed to be implemented using at least one of these technologies. EX1002, ¶207. A POSITA would have found it obvious to implement Kaiser in software stored in memory coupled to a processor such that the software is executed by the processor. EX1002-

Bims, ¶207.

A POSITA would have known that transmitters could be implemented in hardware or software. EX1002-Bims, ¶208. For example, Dowling discloses an OFDM transmitter and explains that various aspects of its OFDM transmitter including its modulation techniques “may be implemented as software modules which execute on a programmable processor architecture.” EX1042, 3:46-50; *see id.* at 5:66-6:1 (disclosing that the transmitter, receiver, and precoder may be implemented in hardware or software”); 21:62-64 (disclosing that the “present invention” is applicable to FFT based multicarrier modulation and OFDM systems). Specifically, Dowling discloses that the “transmitter, receiver, and precoder” can be “constructed using general purpose DSP (digital signal processor) chips, custom VLSI, gate arrays/semicustom VLSI, or a high powered host processor such as a future generation Pentium processor which also runs a computer host operating environment.” EX1042, 6:2-6. Dowling further discloses that its transmitter may be implemented as “a computer program which executes on a processor.” EX1042, 19:14-15. A POSITA would have understood that, in a software implementation, software is stored in memory, and is provided from memory to a processor for execution. EX1002, ¶¶208-209. Indeed, as exemplified by numerous prior art references, those skilled in the art were aware of “software radios” that used code in memory and processors to execute that code to provide flexibility in design and

updating, as opposed to hardware which was significantly more difficult to upgrade because it is fixed in silicon. EX1002, ¶209; EX1008 (describing OFDM-CDMA software radio); EX1011, ¶¶[0124]-[0125] (noting that modulation “and other techniques” can be implemented in “hardware, software, or a combination thereof”). These references have similar disclosures to the ’786 Patent, which states that various aspects “may be implemented in hardware or special purpose circuits, software,” etc. EX1001, 76:37-43; EX1002, ¶209.

A POSITA would have known that transmitters could be implemented in hardware or software. EX1002, ¶210. For example, Dowling discloses an OFDM transmitter and explains that various aspects of its OFDM transmitter including its modulation techniques “may be implemented as software modules which execute on a programmable processor architecture.” EX1042, 3:46-50; *see id.* at 5:66-6:1 (disclosing that the transmitter, receiver, and precoder may be implemented in hardware or software”); 21:62-64 (disclosing that the “present invention” is applicable to FFT based multicarrier modulation and OFDM systems). Specifically, Dowling discloses that the “transmitter, receiver, and precoder” can be “constructed using general purpose DSP (digital signal processor) chips, custom VLSI, gate arrays/semicustom VLSI, or a high powered host processor such as a future generation Pentium processor which also runs a computer host operating environment.” EX1042, 6:2-6. Dowling further discloses that its transmitter may be

implemented as “a computer program which executes on a processor.” EX1042, 19:14-15; EX1002, ¶210.

A POSITA would have understood that, in a software implementation, software is stored in memory, and is provided from memory to a processor for execution. EX1002, ¶211. Indeed, as exemplified by numerous prior art references, those skilled in the art were aware of “software radios” that used code in memory and processors to execute that code to provide flexibility in design and updating, as opposed to hardware which was significantly more difficult to upgrade because it is fixed in silicon. EX1008 (describing OFDM-CDMA software radio); EX1011, ¶¶[0124]-[0125] (noting that modulation “and other techniques” can be implemented in “hardware, software, or a combination thereof”); EX1002, ¶211.

A POSITA also would have expected to succeed in making this combination. Kaiser discloses an OFDM transmitter and defines the various mathematical operations for each of the components. *Supra* §§ VIII(C)(2)(b-f); EX1002, ¶212. Implementing these mathematical operations in software would have required only routine knowledge because software is especially well-suited for performing mathematical operations. EX1002, ¶212. Given the number of disclosures indicating that those in the field were aware that various transmitter functions were able to be implemented in either hardware or software—two known alternatives—a POSITA would have reasonably expected in achieving a software implementation using

instructions stored on a memory for execution by a processor. EX1002, ¶212.

2. Claim 10

a. [10Pre]

As a general rule, preambles are not limiting. *Arctic Cat*, 919 F.3d at 1327-28. For this Petition, however, assuming that claim 1’s preamble limiting, Kaiser in view Bury and Dowling renders obvious an *apparatus for communication in a wireless communication network*. EX1002, ¶213. This preamble corresponds to the preamble of claim 1 except that this preamble is to an apparatus instead of a method. Kaiser in view of Bury disclose an apparatus that, when taken together, performs the method of claim 1 and as such also renders obvious [10Pre]. *Cf. In re Lonardo*, 119 F.3d at 968 (“[T]he claimed structure of the device suggests how it is to be used and that use thus would have been obvious.”). EX1002, ¶213. Moreover, as explained above and in further detail below, the combined teachings of Kaiser in view of Bury and Dowling render claim 10 obvious. *Supra* §VIII(D)(1); *infra* §§VIII(D)(2)(a-g); EX1002, ¶213.

b. [10A], [10B]: processor, memory

Kaiser in view of Bury and Dowling discloses and renders obvious *at least one processor [10A] and a non-transitory computer-readable memory communicatively coupled to the at least one processor, the non-transitory computer-readable memory including a set of instructions stored thereon and executable by*

the at least one processor for [10B] performing the remaining elements of claim 10.
EX1002, ¶214.

Dowling explains that various aspects of an OFDM transmitter including its modulation techniques “may be implemented as software modules which execute on a programmable processor architecture.” EX1042, 3:46-50; *see id.* at 5:66-6:1 (disclosing that the transmitter, receiver, and precoder may be implemented in hardware or software”); 21:62-64 (disclosing that the “present invention” is applicable to FFT based multicarrier modulation and OFDM systems). In a software implementation, software is stored in memory, and is provided from memory to a processor for execution. EX1002, ¶215. Dowling further discloses that its transmitter may be implemented as “a computer program which executes on a processor.” EX1042, 19:14-15; EX1002, ¶215.

A POSITA would have understood that “software radios” with code in memory and processors to execute that code to provide flexibility in design and updating, as opposed to hardware which was significantly more difficult to upgrade because it is fixed in silicon. EX1002, ¶¶216; EX1008 (describing OFDM-CDMA software radio); EX1011, ¶¶[0124]-[0125] (modulation can be implemented in “hardware, software, or a combination thereof”). For the reasons explained above, a POSITA would have found it obvious to implement Kaiser’ transmitter in software stored on memory for execution by a processor coupled to the memory as recited in

claim 10. *Supra* §VIII(D)(1); EX1002, ¶¶216.

Thus, Kaiser in view of Bury and Dowling renders obvious Limitations [10A] and [10B].

c. [10Ci]: selecting subcarriers to be transmitted

Limitation [10Ci] is the same as Limitation [1A]. *Supra* §VIII(C)(2)(b); EX1002, ¶¶218-219 (providing a claim chart comparing the claim limitations). Accordingly, Limitation [10Ci] is obvious for same reasons as Limitation [1A]. *Id.*

d. [10Cii]: encoding data symbols

Limitation [10Cii] is the same as Limitation [1B]. *Supra* § VIII(C)(2)(c); EX1002, ¶¶220-221 (providing a claim chart comparing the claim limitations). Accordingly, Limitation [10Cii] is obvious for same reasons as Limitation [1B]. *Id.*

e. [10Ciii]: applying encoded symbols to subcarriers

Limitation [10Ciii] is the same as Limitation [1C]. *Supra* § VIII(C)(2)(d). EX1002, ¶¶222-223 (providing a claim chart comparing the claim limitations). Accordingly, Limitation [10Ciii] is obvious for same reasons as Limitation [1C]. *Id.*

f. [10Civ]: transmitting spread OFDM signal

Limitation [10Civ] is the same as Limitation [1D]. *Supra* § VIII(C)(2)(e); EX1002, ¶¶224-225 (providing a claim chart comparing the claim limitations). Accordingly, Limitation [10Civ] is obvious for same reasons as Limitation [1D]. *Id.*

g. [10Cv]: complex conjugates

Limitation [10Cv] is the same as Limitation [1E]. *Supra* § VIII(C)(2)(f); EX1002, ¶226-227 (providing a claim chart comparing the claim limitations). Accordingly, Limitation [10Cv] is obvious for same reasons as Limitation [1E]. *Id.*

3. Claim 19

Claim 19 recites a “*computer program product*” with the same limitations as the apparatus limitations in claim 10. EX1002-Bims, ¶228 (providing a claim chart comparing claim 19 and claim 10). Specifically, the “*selecting*,” “*encoding*,” “*applying*,” and “*transmitting*” steps recited in claim 10 are identical to the instructions for “*selecting*,” “*encoding*,” “*applying*,” and “*transmitting*” recited in claim 19. EX1002-Bims, ¶229. Furthermore, both claim 19 and claim 10 conclude with the same wherein clause, as follows: “*wherein the first set of complex-valued codes are complex conjugates of the second set of complex-valued codes.*” EX1002-Bims, ¶229.

As noted above in Section §VIII(D)(4), Dowling further discloses that its transmitter may be implemented as “**a computer program which executes on a processor.**” EX1042, 19:14-15. Furthermore, as established above in § VIII(D)(4), it would have been obvious to a POSITA, in a software implementation, software is stored in memory, and is provided from memory to a processor for execution. EX1002, ¶230. Accordingly, just as the processor and memory recited in claim 10 would have been obvious over Kaiser in view of Bury and Dowling, the “*computer*

program product” recited in claim 19 is rendered obvious by Kaiser in view of Bury and Dowling. Thus, claim 19 is obvious over Kaiser in view of Bury and Dowling for the same reasons as set forth for claim 10 above. §VIII(D)(2); EX1002, ¶230.

4. Claims 11 and 20

Claims 11 and 20 are substantially the same as claim 2. *Supra* §VIII(D)(3); EX1002, ¶¶231-232 (providing a claim chart comparing the claims). Accordingly, claims 11 and 20 are obvious for same reasons as claim 2. *Id.*

5. Claims 15 and 24

Claims 15 and 24 are substantially the same as claim 6. *Supra* §VIII(D)(4); EX1002, ¶¶233-234 (providing a claim chart comparing the claims). Accordingly, claims 15 and 24 are obvious for same reasons as claim 6. *Id.*

6. Claims 16 and 25

Claims 16 and 25 are substantially the same as claim 7. *Supra* §VIII(D)(5); EX1002, ¶¶235-236 (providing a claim chart comparing the claims). Accordingly, claims 16 and 25 are obvious for same reasons as claim 7. *Id.*

7. Claim 17 and 26

Claims 17 and 26 are substantially the same as claim 8. *Supra* §VIII(D)(6); EX1002, ¶¶237-238 (providing a claim chart comparing the claim limitations). Accordingly, claims 17 and 26 are obvious for same reasons as claim 8. *Id.*

8. Claim 18 and 27

Claims 18 and 27 are substantially similar to claim 9. *Supra* §VIII(D)(7); EX1002, ¶¶239-240 (providing a claim chart comparing the claims). Accordingly, claims 18 and 27 are obvious for same reasons as claim 9. *Id.*

IX. DISCRETIONARY DENIAL UNWARRANTED

A. *Fintiv* Factors Favor Institution

The *Fintiv* factors—as applied per the March 24, 2025 Guidance on the USPTO rescission of the Interim Procedure (EX1060, “Boalick Memo”) guides against discretionary denial. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (precedential).

1. Petitioners Will Seek a Stay

Factor 1 favors institution. Petitioner will seek a stay of co-pending litigation pending the outcome of this and related IPRs and reexaminations. The Eastern District of Texas has granted stays before claim construction because such cases have “not reached such an advanced stage that it would weigh against a stay.” *Broadphone LLC v. Samsung Elecs. Co., Ltd.*, 2024 WL 3524022, at *2-3 (E.D. Tex. July 24, 2024) (granting stay where “significant amount of discovery remains, the claim construction hearing has not occurred, and trial is currently set for [over six months later]”).

2. Parallel Proceeding Trial Date

Factor 2 is at worst neutral. A jury trial is scheduled for April 20, 2026.

EX1046, p.1. With this petition being filed in March 2025, a final written decision may be expected by September 2026, only five months after the scheduled trial date, assuming the trial date holds, which, at present is unlikely. Judge Schroeder has scheduled four patent jury trials scheduled for April 20, 2026. EX1061, p.1; EX1062, p.1; EX1063, p.1; EX1064, p.5 (resetting trial to 4/20/2024). “[T]he Board may consider any evidence that the parties make of record that bears on the proximity of the district court’s trial date.” EX1060, p.2. Because four patent cases cannot be tried simultaneously which (if any) trial will proceed is speculative. *Boe Tech. Grp. Co. v. Optronix Scis. LLC*, No. IPR2024-01130, 2025 WL 305477, at *4 (P.T.A.B. Jan. 27, 2025) (Fintiv factor 2 “neutral or weigh[s] slightly in favor of not exercising discretion” where district court “set 10 cases for jury selection on the same day”).

Even when the Final Written Decision (“FWD”) may come after the trial date, the Board has instituted trial based on many of factors present here, such as diligence in filing the petition, a stipulation not to pursue the asserted grounds in litigation, minimal investment in litigation, and the merits of the challenge were strong. *Lego Sys., Inc. v. Mq Gaming LLC*, No. IPR2020-01445, 2021 WL 606917, at *8 (finding jury trial “five months before a final written decision” outweighed by “low” “investment by the court and parties in the [parallel case] on” common issues, Petitioner’s *Sotera* stipulation, and strong merits to the challenge); *Verizon Business*

Network Services, Inc. v. Huawei Techs. Co., IPR2020-01141, Paper 12 (Jan. 14, 2021). Petitioner diligently filed this petition particularly considering the complexity of the analysis undertaken across eight asserted patents that collectively have (1) 638 pages, (2) 243 claims, (3) a range of effective filing dates, and (4) are part of a patent family that was pending before the Office for about two decades. EX1047, ¶1; EX1065. The way Patent Owner structured its patent families, shifted patent disclosures from one application to the next, and, at times, incorporated dozens of patents and publications by reference, placed a significant burden on Petitioner to assess its positions. EX1023, pp.233-236, 241; EX1031, pp.24, 26, 29, 32, 36, 44. The complexity presented by this, and the seven other IPR petitions Petitioner is filing, weigh strongly in favor of institution. *Apple, Inc. v. SEVEN Networks, LLC*, IPR2020-00156, Paper 10 at 21-22 (June 15, 2020) (“complexity of multiple patents and issues in the District Court Action” favored institution). Considering these procedural and technical complexities, the Board is uniquely situated to adjudicate patentability because of its expertise in patent law and technological questions.

3. Investment in Parallel Proceeding

Factor 3 weighs against discretionary denial. The district court case is in the early stages. Fact discovery is in its early stages: no depositions have occurred; expert discovery is many months away. Fact discovery will likely close December 1, 2025. EX1046, p.3. Expert discovery currently starts that same day. *Id.* A

Markman hearing is scheduled for Oct. 21, 2025. *Id.* Where, as here, “the district court[s] ha[ve] not issued orders related to the patent at issue in the petition, this fact weighs against exercising discretion to deny institution.” *Fintiv* at 10.

4. Stipulation Favors Institution

Factor 4 weighs strongly against discretionary denial. Petitioner hereby stipulates that, if the IPR is instituted, Petitioner will not assert that any of the claims challenged in this proceeding are invalid on any ground that Petitioner raised or reasonably could have raised during this inter partes review. *Sotera Wireless, Inc. v. Masimo Corp.*, No. IPR2020-01019, at 19 (finding “stipulation here mitigates any concerns of duplicative efforts...as well as concerns of potentially conflicting decisions” and “ensures that an *inter partes* review is a ‘true alternative’ to the district court proceeding”); *Lego*, 2021 WL 606917, at *6 (“[F]actor weighs strongly against discretionary denial” where Petitioner makes *Sotera* stipulation); *Verizon Business Network Servs, Inc. v. Huawei Techs. Co.*, IPR2020-01141, Paper 12 (Jan. 14, 2021) (“[i]nstituting trial here serves overall system efficiency and integrity goals by not duplicating efforts and by resolving materially different patentability issues.”).

5. Identity of the Parties

Factor 5 is either neutral or weighs slightly against institution because Petitioner and Patent Owner are the same as in district court, but a “holistic view”

favors institution. *Samsung Elecs. Co. Ltd. v. Dynamics Inc.*, IPR2020-00505, Paper 11 at 15 (Aug. 12, 2020).

6. Merits Heavily Favor Institution

Factor 6 favors institution. The compelling merits of the challenge presented herein further weigh heavily in favor of institution. As demonstrated by the Petition, the challenged claims are unpatentable the cited prior art, which was not previously considered despite numerous continuation filings. For example, a single undisclosed reference—Galda—anticipates and/or obviates most challenged claims. The Board’s views on the patentability of the challenged claims will also benefit the public, which is otherwise faced with a thicket of similar and related patents that Patent Owner contends are essential to 4G and 5G wireless standards and which have been asserted against various companies. EX1078. This is the first and only IPR on the ’786 Patent, so a patentability determination by the Board on this Petition would conserve resources.

B. Denial Under §325(d) Unwarranted

The ’786 Patent was not rejected on any prior art, and the prior art in Petitioner’s Grounds was never relied upon by the Examiner during prosecution for a rejection. Therefore, denial under § 325(d) is unwarranted.

X. MANDATORY NOTICES

A. Real Party-In-Interest

Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. are the real parties-in-interest.

B. Related Matters

The '786 Patent is asserted in the following litigation: *GenghisComm Holdings, LLC v. Samsung Electronics America, Inc. f/k/a Samsung Telecommunications America LLC*, No. 24-cv-00242.

Patents in the same or related patent families and which name the same inventor have been challenged in the following post-grant proceedings:

- **U.S. Patent No. 9,768,842:** Samsung Electronics Co., Ltd. v. GenghisComm Holdings, LLC, IPR2025-00780.
- **U.S. Patent No. 10,200,227:** U.S. Reexamination Control No. 90/019,411; *Samsung Electronics Co., Ltd. v. GenghisComm Holdings, LLC*, IPR2025-00781.
- **U.S. Patent No. 10,389,568:** *Samsung Electronics Co., Ltd. v. GenghisComm Holdings, LLC*, IPR2025-00788.
- **U.S. Patent No. 11,223,508:** *Samsung Electronics Co., Ltd. v. GenghisComm Holdings, LLC*, IPR2025-00790; Petitioner also anticipates filing a request for reexamination as to this patent to raise

grounds that cannot be raised in this proceeding.

- **U.S. Patent No. 11,252,005:** U.S. Reexamination Control No. 90/019,847; *Samsung Electronics Co., Ltd. v. GenghisComm Holdings, LLC*, IPR2025-00791.
- **U.S. Patent No. 11,381,285:** *Samsung Electronics Co., Ltd. v. GenghisComm Holdings, LLC*, IPR2025-00792; Petitioner also anticipates filing a request for reexamination as to this patent to raise grounds that cannot be raised in this proceeding.
- **U.S. Patent No. 11,424,792:** U.S. Reexamination Control No. 90/019,848; *Samsung Electronics Co., Ltd. v. GenghisComm Holdings, LLC*, IPR2025-00793.

A patent in the same family as the '786 Patent—i.e., U.S. Patent No. 11,431,386—is asserted in *GenghisComm Holdings, LLC v. Samsung Electronics America, Inc.*, No. 2:24-cv-901-RWS-RSP (E.D. Tex.).

C. Lead and Back-Up Counsel

Petitioner designates the following lead and back-up counsel:

Lead Counsel	Back-Up Counsel
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D. Service

Petitioner consents to service by email on the following email addresses: GT-Genghiscomm-IPR@gtlaw.com.

XI. FEES

The required fee is being paid electronically through P-TACTS.

Dated: April 2, 2025

Respectfully Submitted,

/Trenton A. Ward/

Trenton A. Ward
Reg. No. 59,157

CERTIFICATE OF COMPLIANCE

This petition complies with the word count limits set forth in 37 C.F.R. § 42.24(a)(i), effective May 2, 2016, because this Petition contains 13,739 words, excluding the parts of the petition exempted by 37 C.F.R. § 42.24(a), as determined using the word count provided by Microsoft Word, which was used to prepare this Petition.

Dated: April 2, 2025

Respectfully Submitted,

/Trenton A. Ward/

Trenton A. Ward
Reg. No. 59,157

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e) and 42.105(a), the undersigned certifies that on April 2, 2025, I caused a true and correct copy of **PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 11,075,786, PETITIONER’S POWER OF ATTORNEY BY SAMSUNG ELECTRONICS CO., LTD., PETITIONER’S POWER OF ATTORNEY BY SAMSUNG ELECTRONICS AMERICA, INC., AND EXHIBIT NOS. 1001-1002, 1004-1005, 1007-1008, 1011-1012, 1014-1016, 1019, 1021, 1023-1025, 1030-1032, 1036-1039, 1042-1047, 1059-1069, 1073-1075, 1077, and 1078** by EXPRESS MAIL on the Patent Owner at the correspondence address of record for U.S. Patent No. 11,075,786 as follows:

Mr. Steven J Shattil
P.O. Box 17355
Boulder, CO 80308-0355
UNITED STATES

I further certify that a courtesy copy of the above-identified materials were served on litigation counsel by electronic means upon the foregoing individuals:

Alison Richards, Esq. – aricahrds@giplg.com

/Trenton A. Ward/

Trenton A. Ward
Reg. No. 59,157