

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: IPR2025-00788
U.S. Patent No. 10,389,568

**PETITION FOR *INTER PARTES* REVIEW OF CLAIMS 1-3, 6, 10-11,
20, 24-26, 29, 32-34, 44, 47 OF U.S. PATENT NO. 10,389,568**

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LISTING OF CLAIMS

Claim 1. [1Pre] A method comprising:

[1A] dividing a block of complex-valued symbols into a plurality of sets of complex-valued symbols;

[1B] transform precoding each of the plurality of sets of complex-valued symbols into a block of transform-precoded complex-valued symbols; and

[1C] generating an Orthogonal Frequency Division Multiplex (OFDM) signal comprising a plurality of OFDM subcarriers modulated by the transform-precoded complex-valued symbols,

[1D] wherein the transform precoding generates a plurality of orthogonal spreading codes to provide a superposition of the plurality of OFDM subcarriers with a reduced peak-to-average-power ratio.

Claim 2. The method of claim 1, wherein the transform precoding spreads the block of complex-valued symbols with a plurality of orthogonal spreading codes comprising complex-valued coefficients of a discrete Fourier transform (DFT) to produce the block of transform-precoded complex-valued symbols.

Claim 3. The method of claim 2, wherein the DFT is a fast Fourier transform (FFT).

Claim 6. The method of claim 1, comprising:

mapping the block of transform-precoded complex-valued symbols to

physical resource blocks assigned for transmission of a physical uplink shared channel.

Claim 10. [10Pre] The method of claim 1, comprising:

[10A] scrambling a block of bits of one subframe of a physical uplink shared channel resulting in a block of scrambled bits; and

[10B] modulating the block of scrambled bits resulting in the block of complex-valued symbols.

Claim 11. The method of claim 10, wherein the scrambling is configured to scramble the block of bits into a block of scrambled bits with at least one pseudo-noise code.

Claim 20. The method of claim 1, wherein each of the plurality of sets of complex-valued symbols is a single carrier frequency division multiple access (SC-FDMA) symbol.

Claim 24. [24Pre] An apparatus, comprising:

[24A] a processor; and

[24B] a non-transitory computer-readable memory communicatively coupled to the processor, the memory including a set of instructions stored thereon and executable by the processor for:

[24Ci] dividing a block of complex-valued symbols into a plurality of sets of complex-valued symbols;

[24Cii] transform precoding each of the plurality of sets of complex-valued symbols into a block of transform precoded complex-valued symbols; and

[24Ciii] generating an Orthogonal Frequency Division Multiplex (OFDM) signal comprising a plurality of OFDM subcarriers modulated with the transform-precoded complex-valued symbols,

[24Civ] wherein the transform precoding generates a plurality of orthogonal spreading codes to provide a superposition of the plurality of OFDM subcarriers with a reduced peak-to-average-power ratio.

Claim 25. The apparatus of claim 24, wherein the transform precoding spreads the block of complex-valued symbols with a plurality of orthogonal spreading codes comprising complex-valued coefficients of a discrete Fourier transform (DFT) to produce the block of transform-precoded complex-valued symbols.

Claim 26. The apparatus of claim 25, wherein the DFT is a fast Fourier transform (FFT).

Claim 29. The apparatus of claim 24, comprising instructions for: mapping the block of transform-precoded complex-valued symbols to physical resource blocks assigned for transmission of a physical uplink shared channel.

Claim 32. The apparatus of claim 29, wherein the mapping is configured to select the plurality of OFDM subcarriers according to at least one of a frequency division multiple access scheme, a time division multiple access scheme, a space division

multiple access scheme, a code division multiple access scheme, and a frequency-hopping scheme.

Claim 33. [33Pre] The apparatus of claim 24, comprising instructions for:

[33A] scrambling a block of bits of one subframe of a physical uplink shared channel resulting in a block of scrambled bits; and

[33B] modulating the block of scrambled bits resulting in the block of complex-valued symbols.

Claim 34. The apparatus of claim 33, wherein the scrambling is configured to scramble the block of bits into a block of scrambled bits with at least one pseudo-noise code.

Claim 44. The method of claim 24, wherein each of the plurality of sets of complex-valued symbols is a single carrier frequency division multiple access (SC-FDMA) symbol.

Claim 47. [47Pre] A computer program product, comprising a non-transitory computer readable hardware storage device having computer readable program code stored therein, said program code containing instructions executable by one or more processors of a computer system to implement a method comprising:

[47A] dividing a block of complex-valued symbols into a plurality of sets of complex-valued symbols; and

[47B] transform precoding each of the plurality of sets of complex-valued symbols into a block of transform precoded complex-valued symbols; and

[47C] generating an Orthogonal Frequency Division Multiplex (OFDM) signal comprising a plurality of OFDM subcarriers modulated with the transform-precoded complex-valued symbols,

[47D] wherein the transform precoding generates a plurality of orthogonal spreading codes to provide a superposition of the plurality of OFDM subcarriers with a reduced peak-to-average-power ratio.

PETITIONER’S EXHIBIT LIST

Exhibit No.	Description
1001	U.S. Patent No. 10,389,568 (“’568 Patent”)
1002	Declaration of Harry Bims, Ph.D.
1003	Angela Doufexi, et al., <i>Design Considerations and Initial Physical Layer Performance Results for a Space Time Coded OFDM 4G Cellular Network</i> , In The 13th IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (Vol. 1, pp. 192-196). IEEE (Sept. 18, 2002) (“Doufexi”).
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	Lucent Technologies, <i>Proposed Baseline OFDM Systems for Study</i> , 3GPP TSG-RAN1 #28 bis, R1-02-01246 (Oct. 8-9, 2002) (“Lucent”).
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

Exhibit No.	Description
1011	U.S. Patent Application Publication No. 2003/0081538 to Walton et al.
1012	Declaration of Sylvia Hall-Ellis, Ph.D.
1013	RESERVED
1014	RESERVED
1015	RESERVED
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	RESERVED
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	RESERVED
1025	RESERVED
1026	RESERVED
1027	RESERVED
1028	File History of U.S. Patent Application No. 15/786,270 as obtained from Patent Center (excerpts)
1029	RESERVED

Exhibit No.	Description
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)
1032	File History of U.S. Patent Application No. 12/545,572 as obtained from Patent Center (excerpts)
1033	RESERVED
1034	Declaration of Craig Bishop
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	Marco Breiling, et al., <i>Peak-Power Reduction in OFDM without Explicit Side Information</i> , 5 th Int'l OFDM-Workshop 2000 (Hamburg/Germany), Sept. 2000, pp.28-1 to 28-4.
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</i>

Exhibit No.	Description
	<i>Systems, Seamless Interconnection for Universal Services</i> , 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).
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	Interview Agenda from U.S. Patent Application No. 16/194,290 (obtained from Patent Center)
1050	RESERVED
1051	U.S. Patent No. 6,785,258 to Garcia, Jr., et al. (“Garcia”)
1052	Jack Dongarra, et al., <i>Guest editors introduction to the top 10 algorithms</i> , Computing in Science & Engineering 2(01) (2000), pp.22-23.
1053	U.S. Patent No. 6,263,017 to Miller
1054	U.S. Patent No. 6,175,551 to Awater et al.
1055	U.S. Patent No. 5,204,876 to Bruckert et al.
1056	3GPP TS 36.211 V8.7.0 (2009-05) 3 rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation (Release 8)
1057	David Astély, et al., <i>LTE: The Evolution of Mobile Broadband</i> , IEEE Communications Magazine, pp.44-51 (Apr. 2009).
1058	M. Rinne, et al., <i>LTE, the radio technology path towards 4G</i> , Computer Communications 33 (2010) pp.1984-1906 (2010)

Exhibit No.	Description
1059	Declaration of Gary Swatzell including Exhibits A-D
1060	Guidance on USPTO’s recission 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)
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	RESERVED
1067	RESERVED
1068	RESERVED
1069	RESERVED
1070	RESERVED
1071	The title page, page V, page 14, pages 32-24, pages 130-137, page 140, and page 150 of Kaiser, Stefan. <i>Multi-Carrier CDMA Mobile Radio Systems - Analysis and Optimization of Detection, Decoding, and Channel Estimation</i> . Doctoral Dissertation. Department of Computer Science and Engineering, Technische Universität München. Dusseldorf, Germany: Verein Deutscher Ingenieure (VDI) Verlag, ©1998. Obtained from the University of Mannheim Library in Mannheim Germany.

Exhibit No.	Description
1072	RESERVED
1073	RESERVED
1074	RESERVED
1075	RESERVED
1076	RESERVED
1077	RESERVED
1078	RESERVED
1079	Results of Docket Navigator Search for '568 Patent

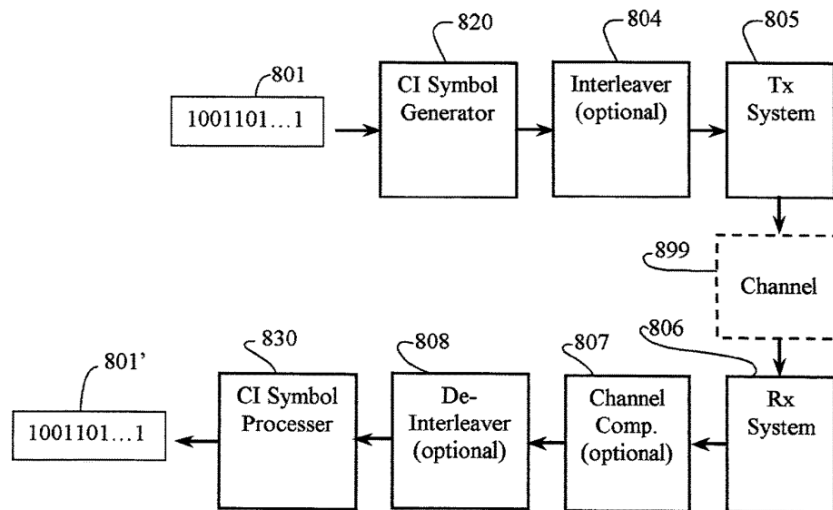
I. GROUNDS FOR STANDING

Petitioner has standing to bring this challenge because 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. THE '568 PATENT

A. Overview of the Patent and Challenged Claims

The '568 Patent describes and ostensibly claims Carrier Interferometry (CI) and CI-based coding. EX1001, 1:29-31. Figure 8A shows “basic components of a CI coding system,” where a stream of data symbols 801 “is processed by a CI symbol generator 802 that outputs” symbol values w_n . *Id.*, 22:55-59.



EX1001, FIG. 8A. “FIG. 7 illustrates a relationship between CI symbol values w_n and data symbols s_n .” *Id.*, 22:21-22.

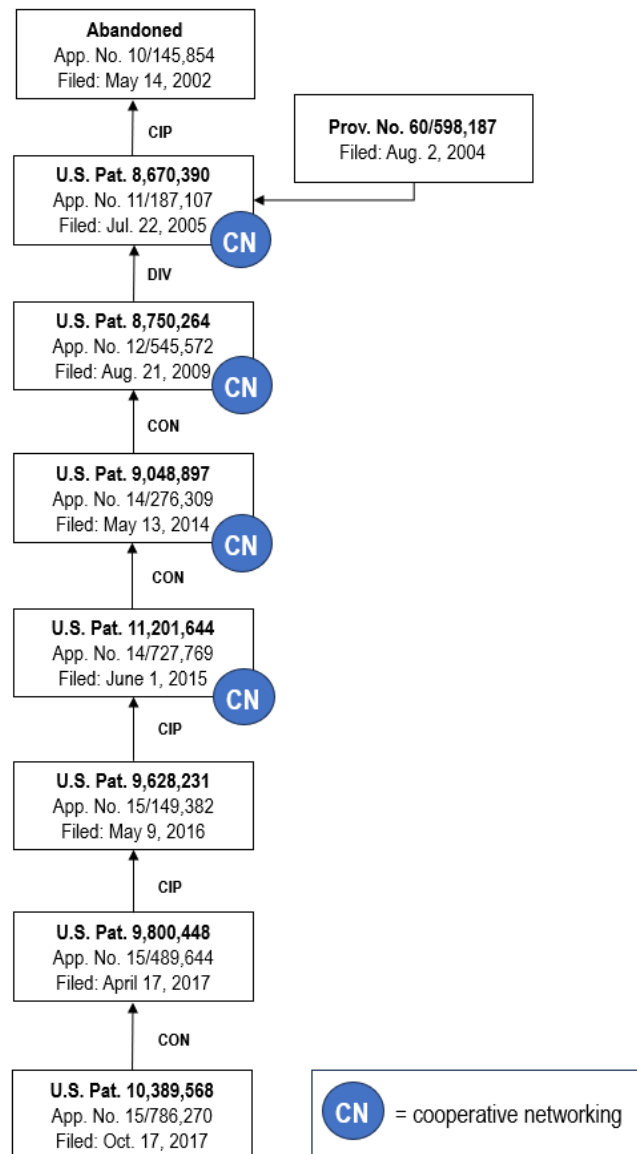
$$\begin{array}{c}
 \begin{array}{cccc}
 s_0() & s_1() & s_2() & s_{N-1}() \\
 \hline
 w_1 = \Sigma(): & e^{i2\pi(0)(0)/(N-1)} & e^{i2\pi(1)(0)/(N-1)} & e^{i2\pi(2)(0)/(N-1)} & e^{i2\pi(N-1)(0)/(N-1)} \\
 w_2 = \Sigma(): & e^{i2\pi(0)(1)/(N-1)} & e^{i2\pi(1)(1)/(N-1)} & e^{i2\pi(2)(1)/(N-1)} & e^{i2\pi(N-1)(1)/(N-1)} \\
 w_3 = \Sigma(): & e^{i2\pi(0)(2)/(N-1)} & e^{i2\pi(1)(2)/(N-1)} & e^{i2\pi(2)(2)/(N-1)} & e^{i2\pi(N-1)(2)/(N-1)} \\
 & & & & \text{703} \\
 w_N = \Sigma(): & e^{i2\pi(0)(N-1)/(N-1)} & e^{i2\pi(1)(N-1)/(N-1)} & e^{i2\pi(2)(N-1)/(N-1)} & e^{i2\pi(N-1)(N-1)/(N-1)}
 \end{array}
 \end{array}$$

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EX1001, FIG. 7. Here, data symbols are multiplied by codes of the form $e^{i2\pi nm/N}$. *Id.* The CI symbols “may be values derived from at least one invertible transform function, such as a Fourier transform....” *Id.*, 22:31-35. CI codes may be applied to OFDM. *Id.*, 19:2. Using CI with “conventional multicarrier protocols” such as OFDM can “eliminate the high peak-to-average power ratios (PAPR) associated with conventional multicarrier protocols.” *Id.*, 3:8-11.

B. Prosecution History

The '568 Application claims priority to seven non-provisional applications and one provisional application. EX1001, cover. The priority claim is summarized below.



'568 Pat. Related U.S. Application Data

In the sections that follow, certain applications (identified with “CN” above) are omitted because they pertain to materially different inventions from that of the '568 Patent. They claim using multiple wireless terminals to cooperatively process or generate signals. *E.g.*, EX1021, p.76 (claiming “cooperative beam-forming in the at least one group of wireless terminals”); EX1032, p.2 (claiming “a plurality of the

mobile wireless terminals to perform cooperative subspace processing”).

1. *Application No. 15/786,270 (Challenged Patent)*

The '270 Application received one Office Action and in it some claims were indicated as including allowable subject matter. EX1028, pp.37-44. Applicant amended the claims to add: “wherein the transform precoding generates a plurality of orthogonal spreading codes to provide a superposition of the plurality of OFDM subcarriers with a reduced peak-to-average power ratio.” *Id.*, pp.20, 26, 32. The claims were then allowed. *Id.*, p.17. None of the references forming the Grounds in this Petition were considered, let alone applied.

2. *Application No. 15/489,644*

The '644 Application was filed on April 17, 2017. EX1036, p.18. A preliminary amendment 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”:

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

EX1036, p.32. This expression is found nowhere in the '644 Application (or any earlier-filed application). The Examiner indicated this (and other) claims were allowable. *Id.*, pp.6, 9, 20.

3. *Application No. 15/149,382*

The '382 Application was filed on May 9, 2016. There were two office actions rejecting claims using references to Kim, Larioa, and Baum. EX1037, pp.33-39, 57-63. Applicant argued that Baum was not prior art because the claims were supported by the '854 Application. *Id.*, pp.22-28. Applicant did not address continuity of disclosure nor did the Examiner seem to appreciate the fact that the '854 Application's text is not found in or incorporated by reference into the '107 Application. *Infra* §§III.A-C. The Examiner focused on the “DFT spreader” and “subcarrier mapper” limitations of the claims when the '382 Application was allowed. EX1037, p.9.

4. *Application No. 14/727,769*

The '769 Application was filed on July 1, 2015. Its claims and prosecution history focus on embodiments related to cooperative networking including things like “a cooperative antenna array” and “a plurality of geographically distributed wireless terminals.” *E.g.*, EX1030, pp.148-149, 304.

The '769 Application was examined under post-AIA law. EX1030, p.89. Even after Applicant disagreed the Examiner continued to apply post-AIA law because the Examiner concluded certain claimed features were not supported by the '572 Application, and instead had support on or after May 13, 2014. EX1030, pp.17, 30, 45, 50-53, 83. Despite removal of these features from the claims by amendment, the

application continued to be examined under post-AIA law because it had included claims that were not entitled to an effective filing date before March 16, 2013.

III. EFFECTIVE FILING DATE; POST-AIA

The effective filing date of the '568 Patent is no earlier than May 13, 2014. Although the description in the '568 Patent is substantively the same as the description in the '854 Application, the '854 Application's description was removed from the applications in the chain of priority at least until it was incorporated by reference into the '309 Application when that application was filed on May 13, 2014. The intervening applications starting with the '107 Application are directed to a different invention requiring the use of multiple wireless terminals to cooperate to transmit and receive signals. There are several reasons that the '568 Patent is a post-AIA patent and those are described below.

A. The '854 Application Disclosure Was Removed From The Description Until At Least May 13, 2014

1. The '568 Patent Has the Same Disclosure as the '854 Application

The '568 Patent is nearly identical to the specification of the '854 Application. *See* EX1023; EX1001. Both have the same figures, EX1023, pp.296-312; EX1001, FIGS. 1A-13D, same descriptions of those figures, *e.g.*, EX1023, pp.230-233, EX1001, 3:31-5:16, same field, EX1023, p.227; EX1001, 1:29-31, same background, EX1023, pp.227-229; EX1001, 1:35-59, and the same laundry list of

37 documents allegedly incorporated by reference, EX1023, pp.233-236; EX1001, 5:21-6:54.

2. *The '107 and '572 Children Applications Substantially Rewrote the Disclosure to Focus on Cooperative Networking Requiring Multiple Wireless Terminals*

While the '568 Patent and the '854 Applications are essentially identical, the intervening '107 and '572 Applications are not like the '854 Application. EX1021, pp.7-98; EX1032; EX1023, pp.227-312. The '107 and '572 Applications are continuations-in-part of the '854 Application. EX1021, p.7; EX1032, p.11. The '107 and '572 Application has none of the same figures, EX1021, pp.83-98; EX1023, pp.296-312; EX1032, pp.86-10, different descriptions of the figures, EX1021, pp.EX1023, pp.230-233; EX1023, pp.12-15, EX1032, pp.16-19, a different field, EX1021, p.7; EX1023, p.227; EX1032, p.11, different background, EX1021, pp.7-10; EX1023, 227-229; EX1032, pp.11-13. And they omit the list of documents allegedly incorporated by reference. Instead, they describe cooperative networking techniques using “WLAN groups” with terminals that cooperate to perform, for example, MIMO operations. *E.g.*, EX1021, pp.22-23; EX1032, p.27; EX1002, ¶¶48-52. A POSTIA reading the '107 and '572 Applications would have understood that they required the use of multiple wireless terminals cooperating to send and/or receive signals. EX1002, ¶53.

3. *The '107 and '572 Children Did Not Incorporate the '854 Application by Reference*

While later applications in the chain, such as the '568 Patent and the '309 Application incorporate the '854 Application by reference, the '107 and '572 Applications do not. *Compare* EX1021, p.7; EX1032, p.11 (no incorporation by reference of '854 Application), *with* EX1031, p.13 (incorporating '854 Application by reference). Therefore, Patent Owner cannot rely on the disclosure of the '854 Application for continuity of disclosure because a priority claim is not an incorporation by reference. *See In re de Seversky*, 474 F.2d 671, 674 (CCPA 1973).

B. The '107 and '572 Applications Describe a Different Invention Directed to Cooperative Networking

The '107 and '572 Applications describe a different invention than the one claimed in the '568 Patent. *Supra* §§III.A.1-3. These applications were titled “Cooperative Beam-Forming in Wireless Networks.” EX1021, p.7; EX1032, p.11. Their field is “providing cooperative signal processing between a plurality of wireless devices.” EX1021, p.7; EX1032, p.11. The Abstract of the '107 Application describes “a cooperative array of wireless terminals.” EX1021, p.82. The Abstract of the '572 Application describes a network that “communicatively coupled together a group of mobile wireless terminals.” EX1032, p.75. The '107 and '572 Applications purport to address a problem that “power, cost, and size constraints typically make the implementation of antenna arrays on mobile wireless terminals

... impractical.” EX1021, pp.9, 16-17; EX1032, pp.13, 21. The invention coordinates among multiple wireless terminals so they operate as a single antenna array. *E.g.*, EX1021, p.16. The embodiments consistently use multiple WTs operating together to transmit or receive signals. EX1002, ¶53. The claims of the ’568 Patent, however, are directed to a transmitter that does not depend on other transmitters. *Id.* Therefore, the ’568 Patent claims are directed to different subject matter than the ’107 and ’572 Applications.

Insofar as Patent Owner attempts to rely on the patent application publications incorporated by reference into the disclosure, *see* EX1021, p.49, these applications describe different inventions and are found in a different patent family. Patent Owner’s reliance on incorporation by reference would have the Board convert the invention of the ’107 Application into the invention disclosed in those other applications. This is improper. *See Modine Mfg. Co. v. U.S. Int’l Trade Comm’n*, 75 F.3d 1545, 1553 (Fed. Cir. 1996) (“[I]ncorporation by reference does not convert the invention of the incorporated patent into the invention of the host patent.”).

C. Because of a Lack of Continuity of Disclosure the ’568 Patent is, at Best, Entitled to An Effective Filing Date of May 13, 2014

The ’568 Application is not entitled to the benefit of the filing date of the ’854 Application. In fact, it is not entitled to an effective filing date of any earlier than May 13, 2014.

Patent Owner was not required to prove entitlement to an earlier effective filing date during prosecution. *Supra* §II.B. “[C]laims in a patent or patent application are not entitled to priority under § 120 at least until the patent owner proves entitlement to the” Board. *Nat. Alts. Int’l, Inc. v. Iancu*, 904 F.3d 1375, 1380 (Fed. Cir. 2018); *Inari Agriculture, Inc. v. Corteva Agriscience LLC*, IPR2024-01014, Paper 15 (Dec. 16, 2024) (Petitioner must persuade the Board only after “a Patent Owner presents argument and evidence that the challenged claims are entitled to [an earlier] priority date.”). To be entitled to the effective filing date of the ’854 Application, “each application in the chain leading back to” that application “must comply with the written description requirement.” *Zenon Envtl. Inc. v. U.S. Filter Corp.*, 506 F.3d 1370, 1378 (Fed. Cir. 2007) (cleaned up). “[I]f any application in the priority chain fails to make the requisite disclosure of subject matter, the later-filed application is not entitled to the benefit of the filing date of applications preceding the break in the priority chain.” *Holmer v. Harari*, 681 F.3d 1351, 1355 (Fed. Cir. 2012).

Because the ’854 Application disclosure was removed when the ’107 and ’572 Applications were filed, there is a lack of continuity of disclosure tracing back to the ’854 Application. This precludes the ’568 Patent from having an effective filing date any earlier than May 13, 2014—the date the ’309 Patent attempted to incorporate the ’854 Application by reference. *Zenon*, 506 F.3d at 1378; *Holmer*, 681 F.3d at

1355.

D. Claims 10, 11, 33, and 34 are not Entitled to an Effective Filing Date Before the Filing of the '568 Patent

Claims 10 and 33 recite “scrambling a block of bits of one subframe of a physical uplink shared channel.” EX1001, cls. 10 & 33. Claims 11 and 34 depend from claims 10 and 33, respectively. None of the specifications spanning from the '854 Application through the application for the '568 Patent describe “scrambling a block of bits of one subframe” as recited in claims 10 and 33. EX1002, ¶54. Indeed, the word “frame” does not appear in the description of the '854 Application or the application for the '568 Patent. *Id.* Therefore claims 10, 11, 33, and 34, are not entitled to an effective filing date before October 17, 2017—when the application for the '568 Patent was filed.

E. The '568 Patent is a Post-AIA Patent

The '568 Patent is a post-AIA patent for several reasons. First, for the reasons explained above, its effective filing date is no earlier than May 13, 2014, thus making it a post-AIA patent. Second, the claims of the '664 Application recite equations plucked from 4G LTE standards and that are found nowhere in the descriptions of any earlier filed patents. *Supra* §§III.A-C. Terms like “PUSCH,” “RB,” “ N_{RB}^{UL} ,” and “ N_{SC}^{RB} ” are defined in the 4G LTE standards but are not found anywhere in the earlier-filed disclosures. EX1036, p.33; EX1038, pp.8-9, 14-15, 31. Because the

mathematical expressions introduced into the claims of the '644 Application are not described in applications filed before April 17, 2017—when they were claimed in the '644 Application by preliminary amendment—the '568 Patent is a post-AIA patent. Third, claims 10, 11, 33, and 34 are not entitled to an effective filing date before October 17, 2017. *Supra* §III.D. Finally, the '568 Patent is a post-AIA patent because one of its parents (the '769 Application) was examined under post-AIA law. *Supra* §II.B.4. Because claims in the family have been determined by the Office to have an effective filing date after March 16, 2013, all subsequent claims in the patent family are post-AIA patents. M.P.E.P. §2159.02.

IV. IDENTIFICATION OF THE CHALLENGE

Petitioner challenges the following claims on the following grounds:

Ground	Claims	Challenge	Statute
1	1-2, 6, 20	Anticipation by Galda	Post-AIA §102(a)(1) or Pre-AIA §102(b)
2		Obviousness over Galda	Post- or Pre-AIA §103
3	3	Galda in view of Bury	
4	10-11	Galda in view of TS36.211	
5	24-25, 29, 32, 44, 47	Galda in view of Dowling	
6	26	Galda in view of Dowling and Bury	
7	33-34	Galda in view of Dowling and TS36.211	
8	1-3, 6, 10-11, 20	Kaiser in view of Bury	
9	24-26, 29, 32-34, 44, 47	Kaiser in view of Dowling and Bury	

V. 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.

VI. THE PERSON OF ORDINARY SKILL IN THE ART (“POSITA”)

Based on the '568 Patent, the prior art and other documentation cited herein, and on Dr. Bims's testimony, a POSITA as of May 14, 2002 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, ¶56. A POSITA would have known that DFT spreading reduces PAPR, that reference signals are used in OFDM systems, and was familiar with hardware and software implementations of mobile transmitters. *Id.*, ¶¶57-59 This level of skill does not materially change regardless of the effective filing date. *Id.*, ¶59.

VII. PRIOR ART STATUS; ANALOGOUS ART

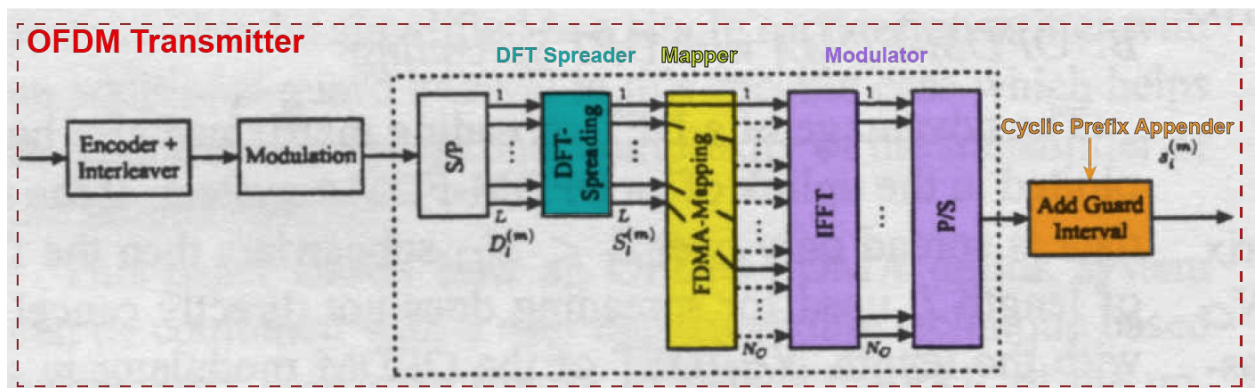
Each reference relied upon in the challenges is analogous prior art. EX1002, ¶¶60-82.

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 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.* CDs 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, there were no confidentiality restrictions imposed on the conference proceedings, EX1059, ¶¶11-12, and it was expected that the proceedings would be shared as indicated by their presence in the Linda Hall Library less than two months later. EX1012, ¶52. Galda is thus a prior art printed publication by at least May 6, 2002 and is prior art under pre-AIA §§ 102(a) or (b) (depending on the claim and effective filing date) or post-AIA § 102(a)(1). *E.g., GoPro, Inc. v. Contour Holding LLC*, 908 F.3d 690, 694-95 (Fed. Cir. 2018).

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 to the '568 Patent because it relates to applying complex-valued codes “derived from at least one invertible function, such as a Fourier transform” to spread symbols in OFDM systems. EX1001, 1:29-31, 3:8-13, 18:9-48, 21:30-34; EX1004, p.1737; EX1002, ¶¶62-64. Galda is also analogous because one problem facing the inventor was reducing PAPR in OFDM communications, EX1001, 3:8-13 (“Adaptations of CI to conventional multicarrier protocols (such as OFDM ...) eliminate the high peak-to-average power ratios (PAPR) associated with conventional multicarrier protocols.”), and Galda solves that problem by spreading symbols using complex-valued codes from a DFT—like the '568 Patent, EX1004, p.1737; EX1002, ¶¶65.

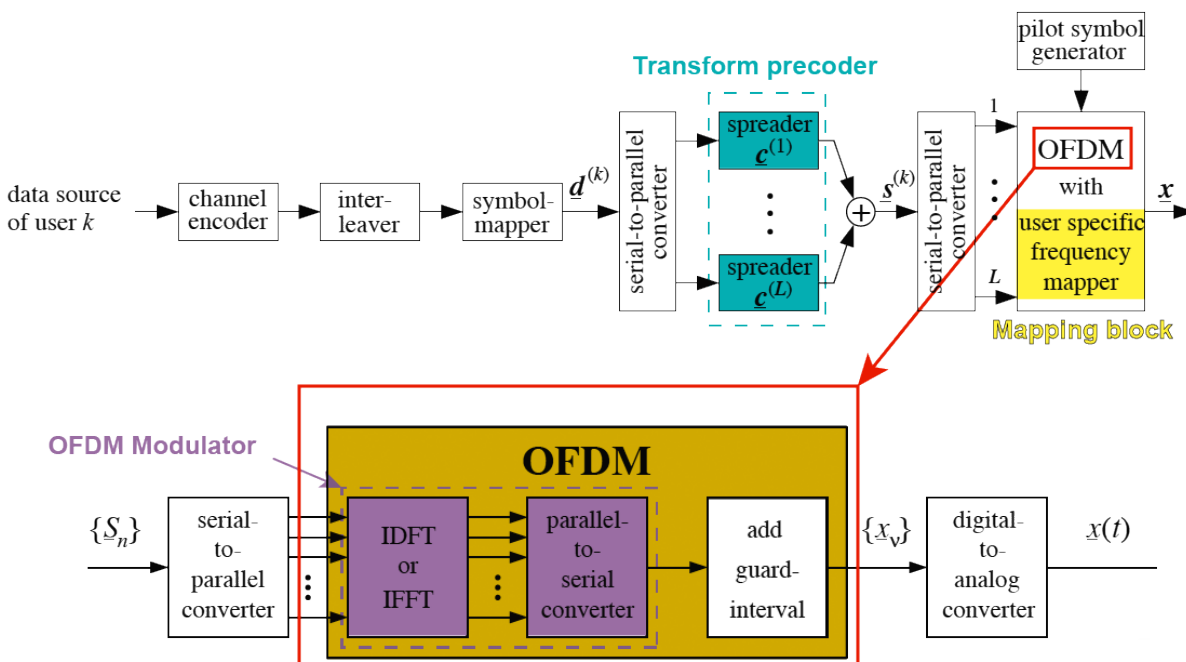
B. Kaiser

Kaiser is a thesis published by VDI-Verlag, Dusseldorf, Germany. EX1005. Kaiser bears a January 1998 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;

¹ Coloring and/or colored text has been added to figures unless otherwise noted.

EX1002, ¶¶66-67. Numerous articles predating May 2002 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 a transform precoder, a mapping block, an OFDM modulator, and a guard-interval appender:



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

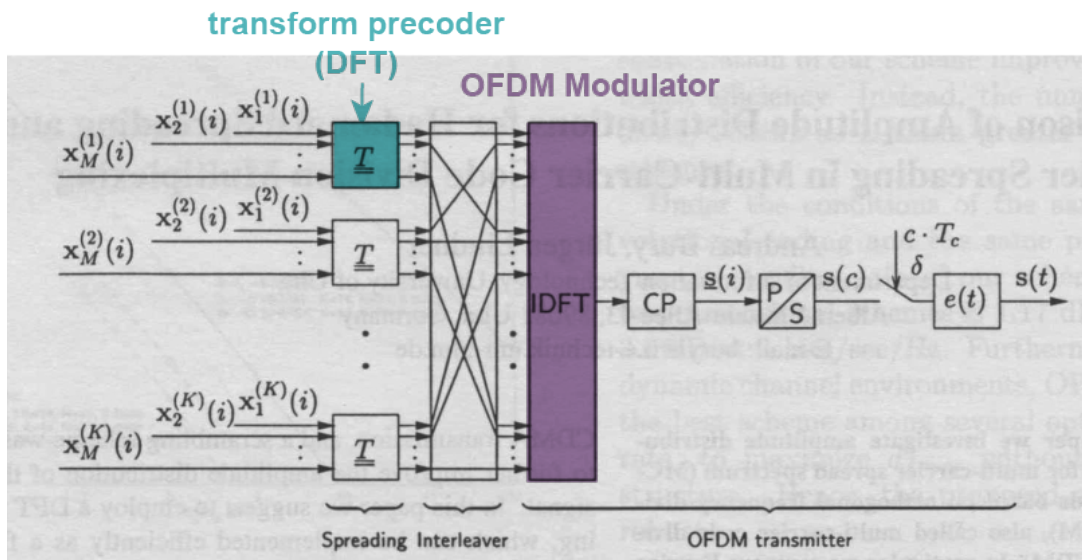
Kaiser is analogous because it is in the field of spread OFDM. EX1001, 1:27-29; EX1005, pp.130-37 (describing spread spectrum multiple access); EX1002, ¶¶68-70. Kaiser is also analogous because a problem facing the inventor was to achieve more efficient use of bandwidth in communication systems, EX1001, 2:53-59, and Kaiser achieves “high bandwidth efficiency and great flexibility” using SS-

MC-MA. EX1005, p.137; EX1002, ¶71.

C. Bury

Bury is a conference paper. EX1007. Exhibit 1007 was obtained from the Linda Hall Library, which cataloged the proceedings into its collection on January 12, 2001. EX1012, ¶¶8, 60-61. Bury was cataloged by subject matter using terms that a POSITA would have reasonably used to locate it. EX1012, ¶¶37, 63-64; EX1002, ¶72. Bury is thus prior art under pre-AIA §102(b) or post-AIA §102(a)(1).

Bury discloses an OFDM transmitter including a transform (DFT) precoder that operates on blocks of signals and an OFDM modulator:



EX1007, p.858 (Fig. 1(a) (annotated)). Bury concludes that DFT-spreading codes/matrices should be used instead of Walsh-Hadamard codes to reduce PAPR. EX1007, pp.857, 860.

Bury is analogous because it relates to applying DFT spreading codes—an

example of CI codes—to spread data symbols in OFDM systems. EX1001, 19:1-2, 21:30-34; EX1007, pp.857-860; EX1002, ¶¶73-74. Bury is also analogous because a problem facing the inventor was reducing PAPR in OFDM communications, EX1001, 3:8-13, and Bury solves that problem by spreading symbols using complex-valued codes from a DFT, EX1007, pp.857, 860; EX1002, ¶75.

D. TS36.211

TS36.211 is a published technical specification made available on the 3GPP website on June 8, 2009. EX1034, ¶¶58-65. The 3GPP website was somewhere that a POSITA would have gone to learn about technical standards for wireless communications, including the 4G LTE specifications, of which TS36.211 is a part. EX1002, ¶76; EX1034, ¶¶58-65. A POSITA would have been able to locate TS36.211 on the 3GPP website by looking for technical specifications that had been released and by looking for the title “Physical channels and modulation” to learn more about how physical channels and modulation were employed in LTE. EX1002, ¶77. Therefore, TS36.211 was publicly accessible and thus a printed publication under post-AIA §102(a)(1).

TS36.211 discusses physical channels and modulation in LTE systems. EX1056, p.7. Among the features described is the physical uplink shared channel (“PUSCH”). *Id.*, p.15. TS36.211 describes scrambling bits before they are modulated to generate complex-valued symbols:

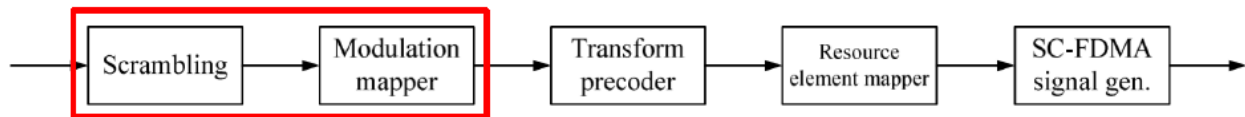


Figure 5.3-1: Overview of uplink physical channel processing.

EX1056, p.13. Scrambling is performed on a block of bits to be “transmitted on the physical uplink shared channel in one subframe.” *Id.*

TS36.211 is in the same field as the '568 Patent because it describes techniques like spreading using values derived from a Fourier transform, EX1001, 21:32-35; EX1056, pp.14-15 (“Transform precoding”). Additionally, it is reasonably pertinent to the problems allegedly solved by the inventor of the '568 Patent including “bandwidth efficiency” and “increased throughput,” EX1001, 2:53-59, because 4G had higher bandwidth efficiency and throughput than earlier wireless standards like CDMA and GSM, EX1002, ¶¶78-79.

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 '568 Patent at least because it is in the same

field—namely wireless communications networks with transceivers and using CI precoding. EX1001, 1:29-31, EX1042, 1:6-12 (“field” relates to “data transmission,” more specifically to a “precoder” for multicarrier (e.g., OFDM) systems), 21:62-64 (invention “applied to other FFT based multicarrier modulation and OFDM systems.”); EX1002, ¶¶80-82.

VIII. DETAILED DISCUSSION

A. Grounds 1 and 2: Claims 1-2, 6, and 20 are (Ground 1) anticipated by or (Ground 2) obvious over Galda.

1. Claim 1

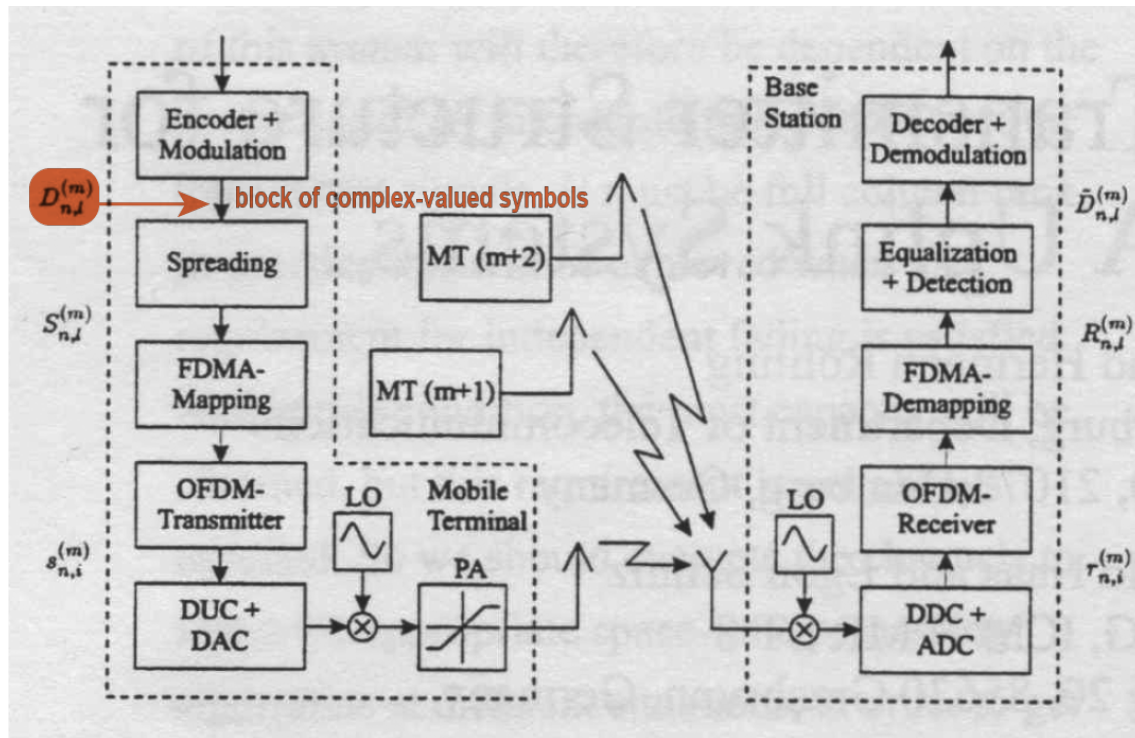
a. [1Pre] A method

[1Pre] is a generic non-limiting preamble. Galda discloses and renders obvious the steps of claim 1. EX1002, ¶¶83-95.

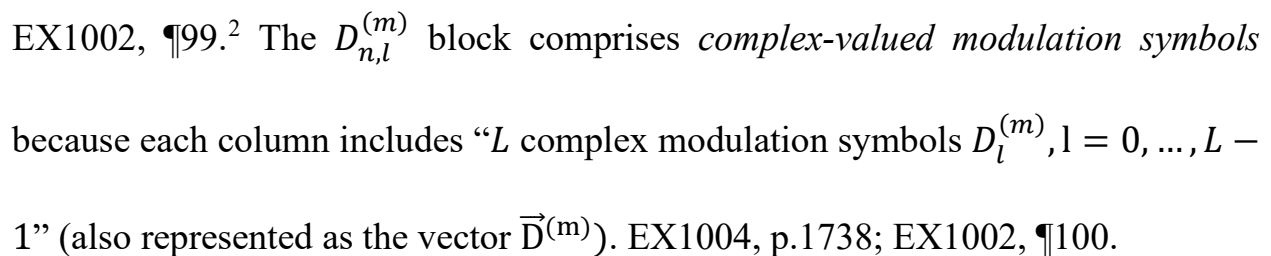
b. [1A] dividing into sets

Galda discloses and renders obvious *dividing a block of complex-valued symbols* ($D_{n,l}^{(m)}$ is divided) *into a plurality of sets of complex-valued symbols* (sets of “ L complex modulation symbols $D_l^{(m)}, l = 0, \dots, L - 1$ ”). EX1002, ¶¶96-103.

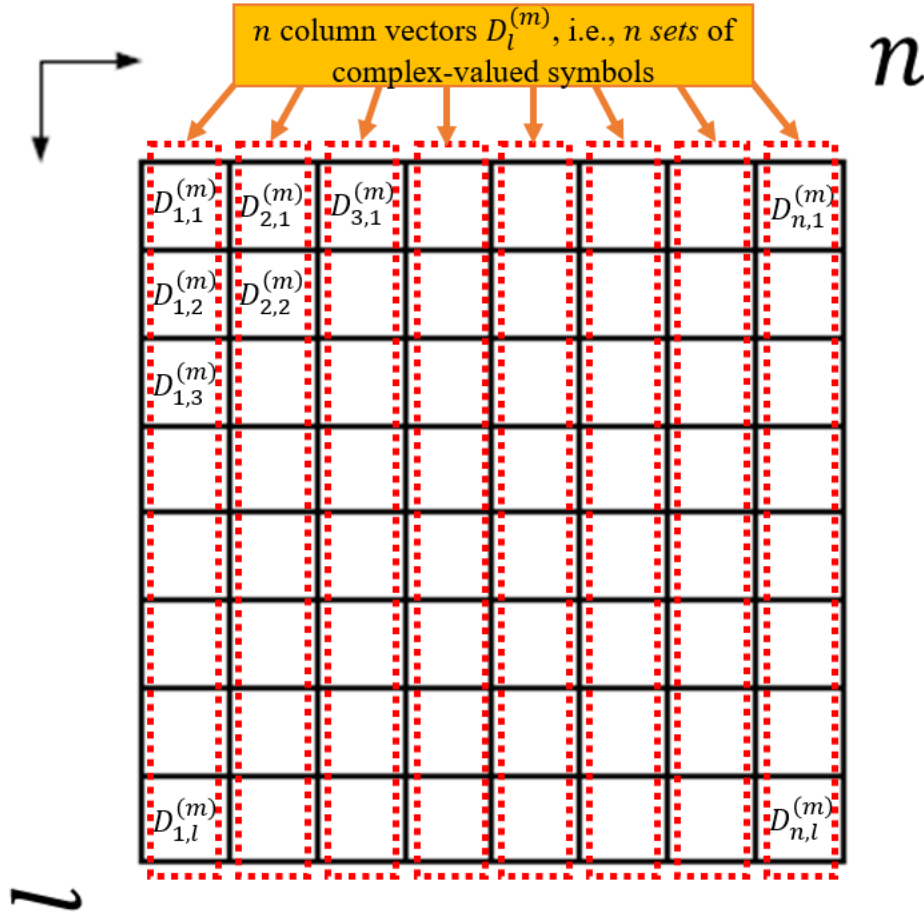
Galda discloses an L -by- N block of complex-valued symbols generated by Galda’s “Encoder + Modulation” block where the *block of complex-valued symbols* is identified as $D_{n,l}^{(m)}$:



EX1004, p.1738 (Fig. 1). A POSITA would have understood from subscripts “ n ” “ l ” that $D_{n,l}^{(m)}$ is an L -by- N matrix, where “ l ” and “ n ” are row and column indices. EX1002, ¶¶97-98. At the very least, this would have been obvious because this same nomenclature is used in the ’568 Patent. EX1001, 18:9-15 (“ m and n are row and column indices” for ϕ_{mn}). The matrix representation of Galda’s $D_{n,l}^{(m)}$ is shown below:



² The indices may start at 0 or 1; here both start at 1. EX1002, ¶99.



EX1002, ¶101. Galda simplifies its subsequent discussion of the modulation symbols by dropping the n index and referring to a column vector of complex-valued modulation symbols. EX1002, ¶102. Nevertheless, a POSITA would have understood that this process for one *set of complex-valued symbols* (“ L complex modulation symbols $D_l^{(m)}$, $l = 0, \dots, L - 1$ ”) was performed for each of the n sets of complex-valued symbols output from the “Encoder+Modulation” block. *Id.* At the very least, it was obvious to implement n sets of complex-valued symbols because

Galda explicitly discloses a variable size block with multiple columns as indicated by the variable n and dividing and serially spreading and modulating would be used for any data transmission over L symbols in length. EX1002, ¶102.

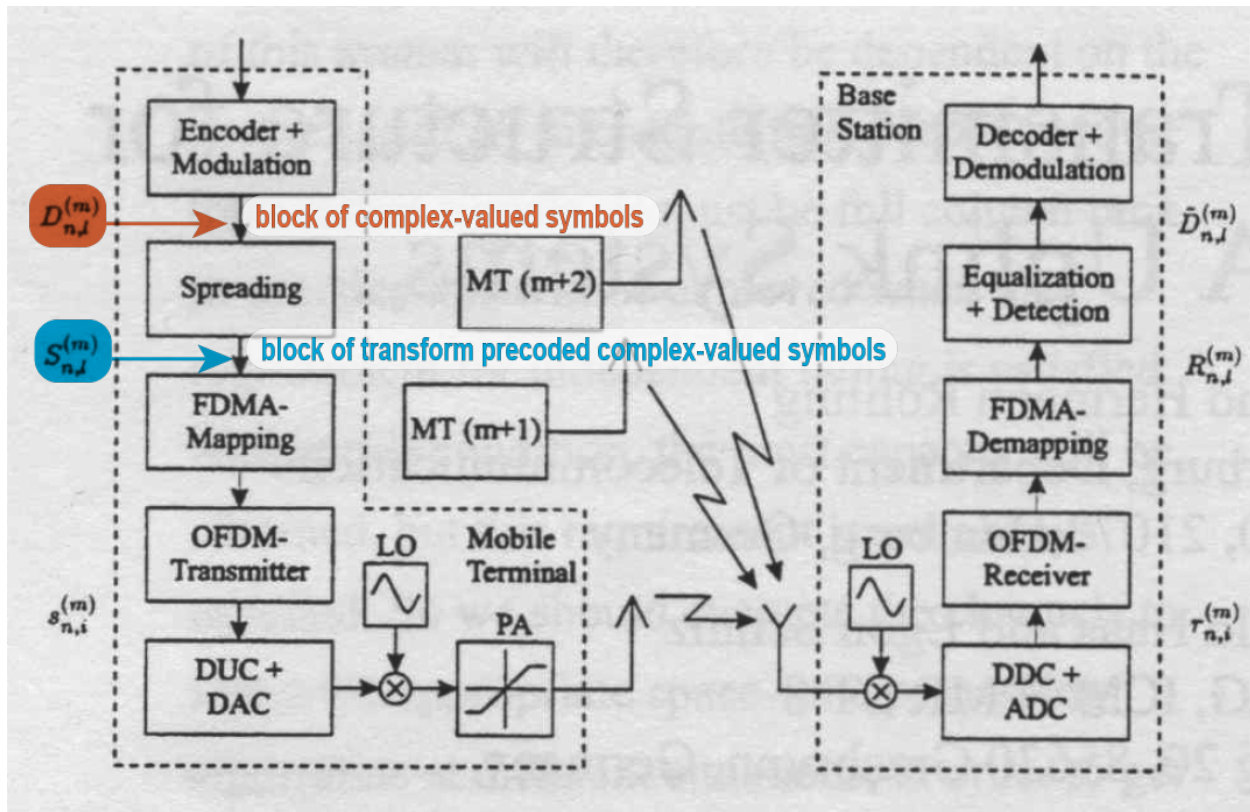
Thus, Galda discloses and renders obvious Limitation [1A].

c. [1B]: transform precoding

Galda discloses and renders obvious *transform precoding*³ each of the plurality of sets of complex-valued symbols (multiplying n vectors $\vec{D}^{(m)}$ of “ L complex modulation symbols $D_l^{(m)}, l = 0, \dots, L - 1$ ” obtained from block $D_{n,l}^{(m)}$ by “unitary spreading matrix $[C]$, which is a “DFT spreading matrix”) into a block of *transform-precoded complex-valued symbols* (into vectors of “ L complex transmit symbols $S_l^{(m)}$ ($\vec{S}^{(m)}$) that make up block $S_{n,l}^{(m)}$.” EX1002, ¶¶104-09.

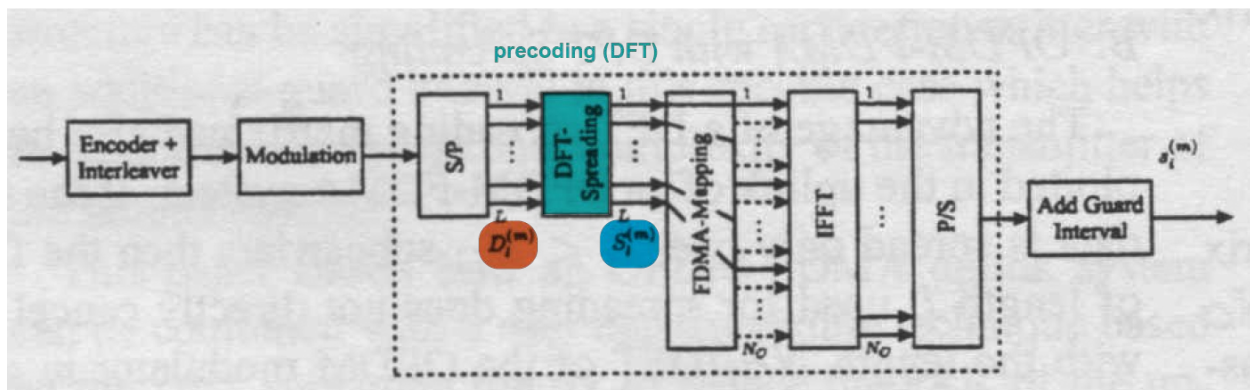
Galda discloses *transform precoding* via DFT-spreading. Galda’s spreading is performed on each of the n sets of complex modulation symbols $D_l^{(m)}$, thereby resulting in a block of *transform-precoded complex-valued symbols* $S_{n,l}^{(m)}$:

³ “Precoding” does not appear in the description of the ’568 Patent. Claim 2 says “transform precoding spreads the block of complex-valued symbols” with DFT coefficients to produce “transform-precoded complex-valued symbols.” Thus, spreading “complex-valued symbols” with DFT codes is a form of precoding.



EX1004, p.1738 (Fig. 1); EX1002, ¶¶104-06.

Galda also shows DFT-spreading of one vector (column of block $D_{n,l}^{(m)}$) of complex-valued symbols $D_l^{(m)}$:



EX1004, p.1740 (Fig. 6(a)). The DFT-spreading block multiplies *each set of*

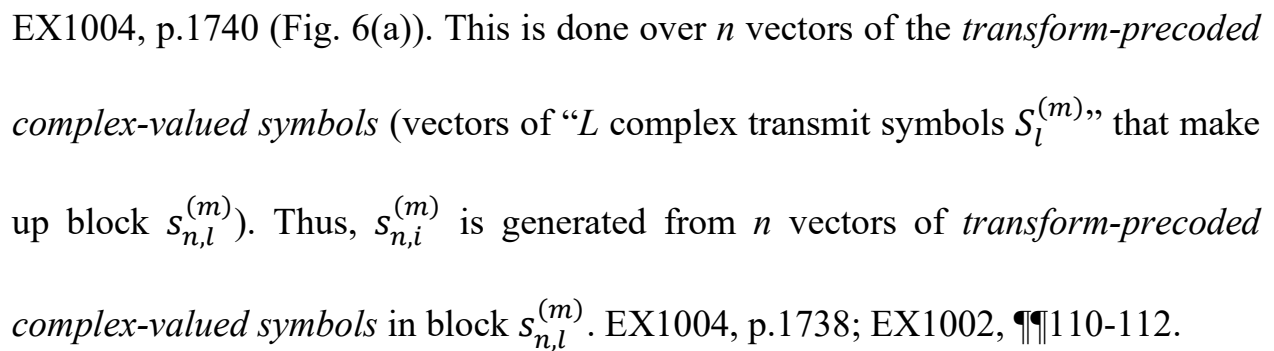
complex-valued symbols $D_l^{(m)}$ by “DFT spreading matrix,” which is a “unitary spreading matrix” designated $[C]$ in Galda. EX1004, p.1738. The spreading operation is “denoted mathematically by the following simple matrix multiplication $\vec{S}^{(m)} = [C]\vec{D}^{(m)}$.” This spreads L modulation symbols over the L user specifically allocated subcarrier and produces L complex transmit symbols $S_l^{(m)}$. *Id.*; EX1002, ¶¶107-08. Galda’s Fig. 1 shows that this is repeated over n plurality of input complex data symbol vectors to produce *a block of transform-precoded complex-valued symbols* shown as block $S_{n,l}^{(m)}$. EX1002, ¶108; EX1004, p.1738.

Thus, Galda discloses and renders obvious Limitation [1B].

d. [1C]: generating an OFDM signal

Galda discloses and renders obvious *generating an Orthogonal Frequency Division Multiplex (OFDM) signal* (using Galda’s IFFT and P/S to generate $S_{n,i}^{(m)}$) *comprising a plurality of OFDM subcarriers modulated by the transform-precoded complex-valued symbols* (L subcarriers are modulated by n vectors of “ L complex transmit symbols $S_l^{(m)}$,” that make up block $s_{n,l}^{(m)}$). EX1002, ¶¶110-13.

Galda maps “ L complex transmit symbols $S_l^{(m)}$,” to OFDM subcarriers to produce an *OFDM signal*:



e. [1D]: reduced PAPR

Galda discloses and renders obvious *wherein the transform precoding generates a plurality of orthogonal spreading codes* (codes from “unitary spreading matrix [C]” which is a “DFT spreading matrix”) *to provide a superposition of the plurality of OFDM subcarriers with a reduced peak-to-average-power ratio* (the resulting OFDM signal is a superposition of subcarriers with lower PAPR). EX1002, ¶¶114-21.

Galda’s generated signal comprises a superposition of OFDM subcarriers: “[f]or a sufficiently large number L of used subcarrier per user the time discrete OFDM signal $s_i^{(m)}$ of user m ...has an approximately Gaussian amplitude distribution due to the superposition of statistically independent modulation symbols $S_t^{(m)}$ on all used subcarriers.” EX1004, p.1740; *see also id.*, p.1737; EX1002, ¶¶114-15.

Galda says: “using the Discrete Fourier Transform (DFT) matrix as an orthogonal spreading technique will reduce the PAR significantly [sic].” EX1004, Abstract; *see id.*, p.1739 (restating the same). Galda’s PAR refers to *peak-to-average power ratio* (PAPR). Galda defines PAR as:

$$PAR = 10 \log_{10} \left(\frac{\max(|s(t)|^2)}{\sigma_s^2} \right) [dB], \text{ where } \sigma_s^2 \text{ denotes the average transmit power.}$$

EX1004, p.1740. PAR is peak-to-average power ratio because $\max(|s(t)|^2)$

represents the peak (“max”) transmit power of a signal and σ_s^2 is the average transmit power. EX1002, ¶¶116-20. Other references confirm that “PAR” refers to “peak-to-average power ratio.” See EX1040, p.28-1 (“We propose a novel method for reducing the ppeak-to-average power ratio (PAR) of the transmit signal....” (emphasis original)).

Thus, Galda discloses and renders obvious Limitation [1D] and claim 1.

2. *Claim 2*

Galda discloses and renders obvious *wherein the transform precoding* (Galda’s DFT spreading) *spreads the block of complex-valued symbols ($D_{n,l}^{(m)}$) with a plurality of orthogonal spreading codes comprising complex-valued coefficients of a discrete Fourier transform (DFT) (codes from “unitary spreading matrix [C]” which is a “DFT spreading matrix”) to produce the block of transform-precoded complex-valued symbols ($s_{n,l}^{(m)}$) for the reasons given for claim 1. Supra §VIII.A.1; EX1002, ¶¶122-23.*

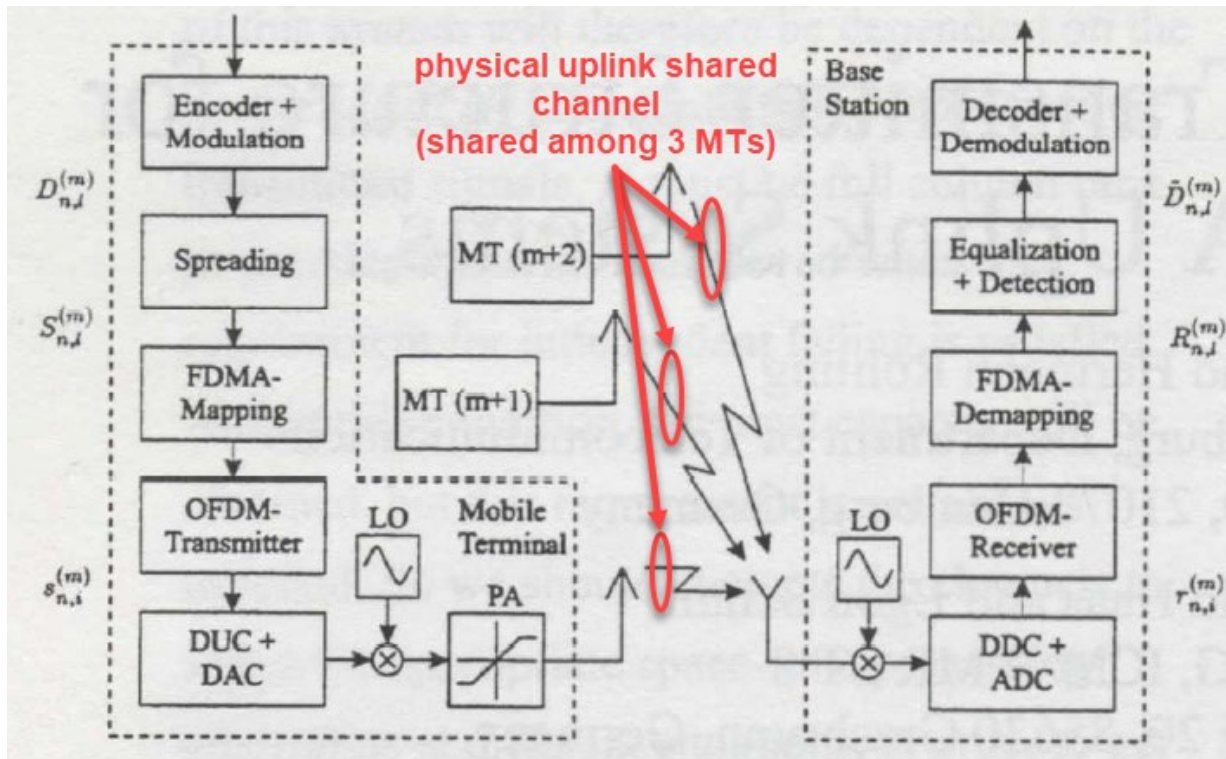
Thus, Galda discloses and renders obvious claim 2.

3. *Claim 6*

Galda discloses *mapping the block of transform-precoded complex-valued symbols ($s_{n,l}^{(m)}$) to physical resource blocks assigned for transmission of a physical uplink shared channel* (user m is assigned L of the available N_C subcarriers that have

a symbol duration in the time domain and other users use different subcarriers). EX1002, ¶¶124-28.

Galda says “[t]he transmit symbols $S_l(m)$ are then mapped onto L of the available N_C subcarrier which are exclusively allocated to user m ,” thus describing *mapping the block of transform-precoded complex-valued symbols to physical resource blocks assigned for transmission of a physical uplink shared channel*. EX1004, p.1738. Galda’s *physical resource blocks* correspond to L of the available N_C subcarriers in the frequency domain and one symbol duration for each of the n vectors of *block of transform-precoded complex-valued symbols* ($s_{n,l}^{(m)}$) in the time domain. EX1004, p.1738; EX1002, ¶¶125-26. The *physical uplink shared channel* is the total number of subcarriers N_C shared among M users. EX1004, p.1738. Galda’s physical resource blocks are *assigned for transmission* because “each user allocates L different subcarriers exclusively” and “any L out of N_C subcarrier[s] that have not been assigned to another user” can be used. EX1004, p.1738; EX1002, ¶127.



EX1004, p.1738 (Fig. 1); *id.*, p.1741 ($N_C=512$, $M=16$ users).

Thus, Galda discloses and renders obvious claim 6.

4. Claim 20

Galda discloses *wherein each of the plurality of sets of complex-valued symbols is a single carrier frequency division multiple access (SC-FDMA) symbol.*

EX1002, ¶¶129-30.

Galda says “the time signal of the OFDM-FDMA uplink with DFT spreading is identical to a single carrier transmission[.]” EX1004, p.1740. This consequence of Galda’s DFT spreading was known. EX1002, ¶129 (citing EX1016, p.2332 (Using “an FFT matrix as spreading matrix for OFDM-CDM leads to a single-carrier system”

with guard interval.”)). Thus, *each of the plurality of sets of complex-valued symbols* $S_l(m)$ is mapped to L subcarriers and is OFDM modulated thus forming *a single carrier frequency division multiple access (SC-FDMA) symbol* ($S_i^{(m)}$) in Galda’s “OFDM-FDMA uplink.” EX1004, pp.1739-40.

Thus, Galda discloses and renders obvious claim 20.

B. Ground 3: Claim 3 is obvious over Galda in view of Bury

Galda in view of Bury renders obvious *wherein the DFT is a fast Fourier transform (FFT).*” EX1002, ¶¶131-33.

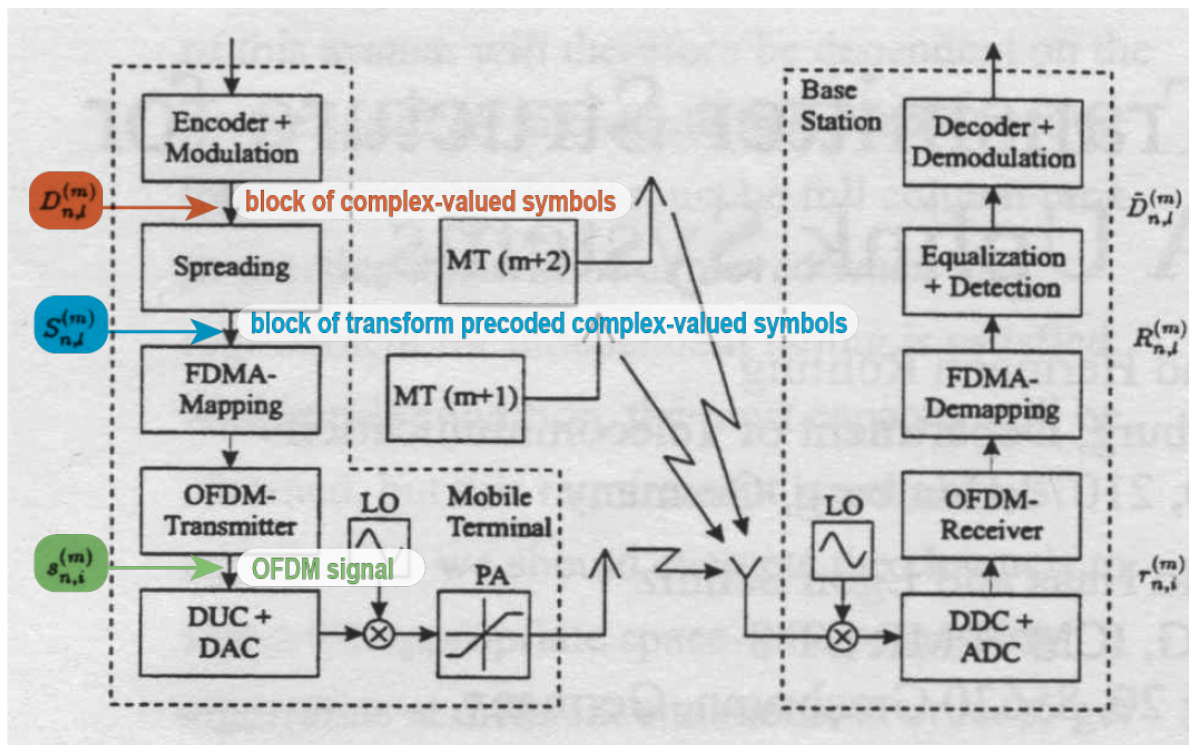
Galda discloses a DFT. *Supra* §§VIII.A.1.c (Limitation [1B]), VIII.A.2 (claim 2). Galda does not explicitly state that its DFT is a FFT. Bury employs “a DFT for spreading, which can be implemented efficiently as a fast Fourier transform (FFT).” EX1007, p.857. FFTs were described as “the most ubiquitous algorithm in use today to analyze and manipulate digital or discrete data.” EX1052, p.23. A POSITA would have been motivated to use a FFT to perform Galda’s DFT spreading because an FFT was an efficient way to implement a DFT and was a “ubiquitous algorithm.” EX1007, p.857; EX1052, p.23; EX1002, ¶132. A POSITA would have reasonably expected to succeed because the FFT was ubiquitous and was “an algorithm ‘the whole family can use.’” EX1052, p.23; EX1002, ¶133.

Thus, Galda in view of Bury renders obvious claim 3.

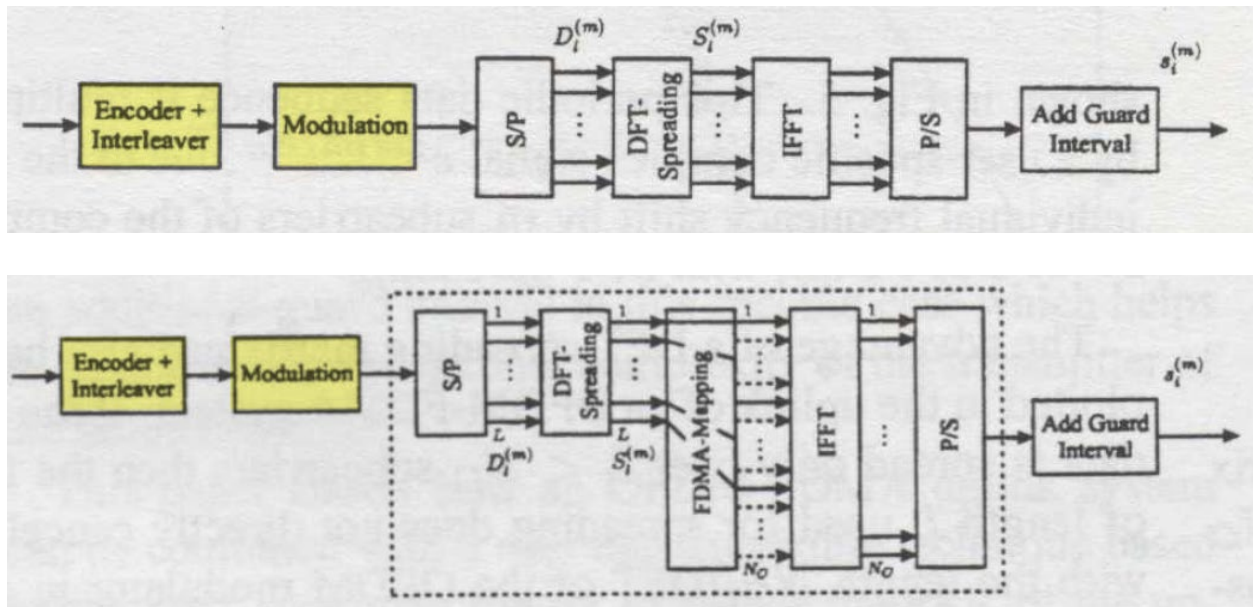
C. Ground 4: Claims 10-11 are obvious over Galda in view of TS36.212

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

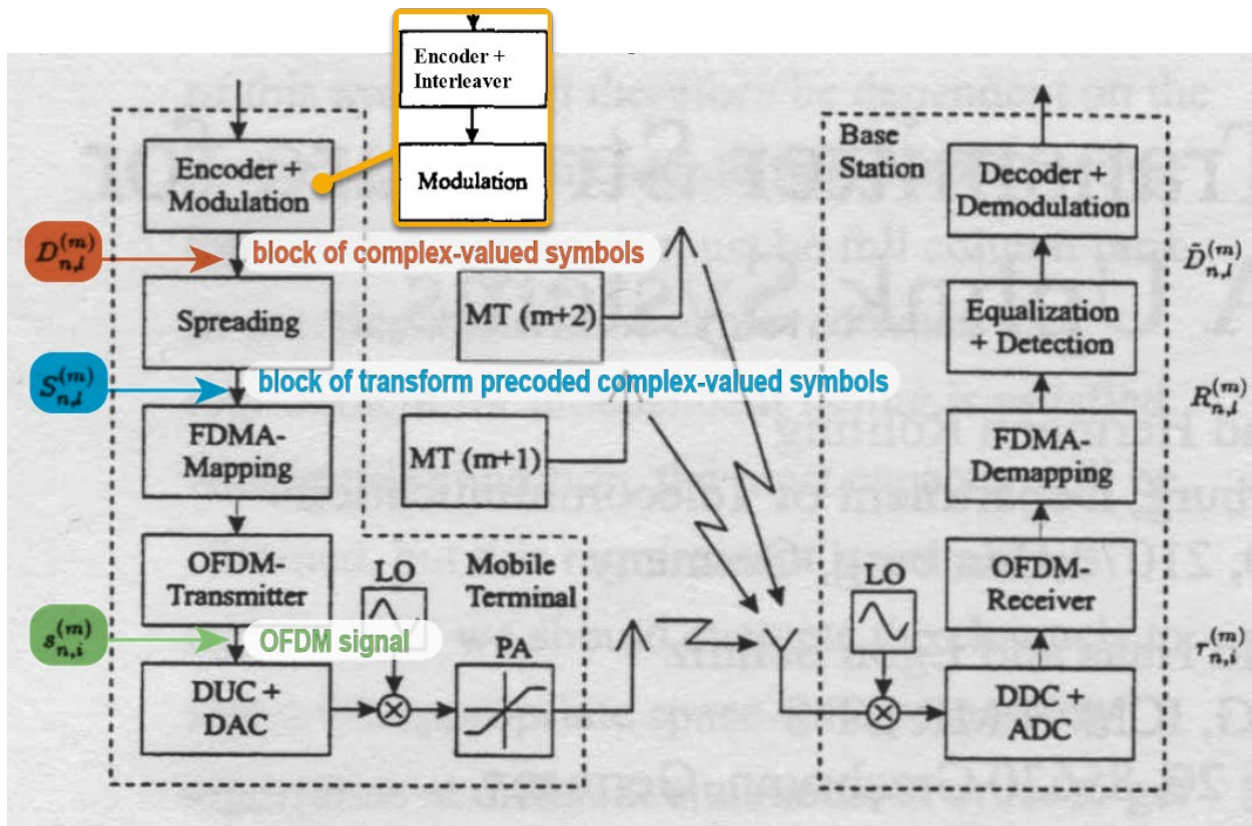
Galda discloses an “Encoder + Modulation” element that maps a bit sequence onto complex-valued symbols $D_{n,l}^{(m)}$.



EX1004, p.1738 (Fig. 1); EX1002, ¶134. Galda shows Fig. 1’s “Encoder + Modulation” implemented as “Encoder + Interleaver” block followed by “Modulation” block in Figs. 4 and 6.



EX1004, p.1738. A POSITA would have thus understood that in the context of Fig. 1, "Encoder + Modulation" is shorthand for "Encoder + Interleaver" and "Modulation" shown in Figs. 4 and 6 as is shown in the modified version of Fig. 1 below:



EX1004, p.1738; EX1002, ¶136.

Galda does not mention *scrambling a block of bits of one subframe of a physical uplink shared channel resulting in a block of scrambled bits*. However, by the October 17, 2017 effective filing date of claims 10, 11, 33, and 34, a POSITA would have found it obvious to scramble blocks of bits of one subframe of a physical uplink shared channel before modulating them with Galda’s modulator based on TS36.211.

TS36.211 describes scrambling a block of bits to be “transmitted on the physical uplink shared channel in one subframe” where the scrambling is performed using “a UE specific scrambling sequence prior to modulation, resulting in a block

of scrambled bits” EX1056, p.14. The scrambling sequence is a “pseudo-random sequence.” *Id.*, pp.78-79. This describes a pseudo noise code. EX1002, ¶¶135-38.

A POSITA would have been motivated to add TS36.211’s scrambler to perform a step of *scrambling a block of bits of one subframe of Galda’s physical uplink shared channel resulting in a block of scrambled bits* so that the scrambled bits are input into Galda’s modulator for *modulating the block of scrambled bits resulting in a block of complex-valued symbols* because (1) it would further reduce the peak amplitude of an OFDM transmitters output waveform and enhance power consumption efficiency, and (2) it would randomize the bit stream thus permitting improved forward error correction. EX1002, ¶139. A POSITA knew that scrambling provided several benefits in OFDM communications. Additionally, using the frame and subframe structures discussed by TS36.211 would have permitted techniques like frame synchronization to be performed.

First, a POSITA knew that scrambling before modulation can reduce PAPR by avoiding long runs of 0’s or 1’s, which can lead to high correlation in phase of the resulting OFDM signal and thus high PAPR. EX1051, 2:29-37; EX1002, ¶139; *see* EX1053, 16:38-41, 23:17-22 (scrambling is “common practice in modems,” and “without scrambling an input string of zeros will produce a modulated, but strongly correlated output without a DC component”).

Second, when retransmissions are needed because of errors in received packet

data, decorrelation of the data bits by scrambling can improve the likelihood of successful receipt of the data. EX1054, 6:25-33; EX1055, 12:12-16 (“wherein the forward error correction encoder means comprises a symbol interleaver means for scrambling the data symbols prior to the modulator means”); EX1002, ¶140.

And a POSITA knew that subframes were used in LTE (e.g., TS36.211) to organize and manage data transmissions across users in then-existing OFDM networks. EX1002, ¶141; EX1057, p.45 (“The scheduler determines, for each 1 ms subframe, which user(s) are allowed to transmit, on what frequency resources the transmission is to take place, and what data rate to use.”). Galda is silent on any type of framing used in OFDM transmissions. A POSITA would have seen that using the LTE frame/subframe would have enabled “dynamically schedul[ing]” resources for uplink communications and do so in “a high resolution of one subframe....” EX1058, p.1902.

A POSITA would have found it obvious to include TS36.211’s scrambling a block of bits of a subframe before Galda’s modulator because it would have applied TS36.211’s known scrambling and framing techniques to improve Galda’s system in the same way—by decorrelating the data bits before modulating them to assist with PAPR reduction and allowing scheduling resources on a subframe basis. EX1002, ¶142. Additionally, applying TS36.211’s known technique to Galda’s known method, which was ready for improvement and in need of avoiding long runs

of 0's or 1's to yield predictable results of decorrelating the data stream thereby reducing PAPR and enabling retransmissions to be more likely received by applying a different scrambling vector to them and permitting scheduling on a subframe basis. EX1002, ¶143; EX1051, 4:20-22, 4:47-53, 8:40-43; EX1053, 16:38-41, 23:17-22; EX1054, 6:25-33; EX1055, 12:12-16.

A POSITA also would have expected to succeed in making this combination. Galda and TS36.211 have related teachings, are in the same field as the '568 Patent, and describe techniques for OFDM transmitters. EX1002, ¶144. Moreover, scrambling is “common practice” EX1053, 16:38-41, 23:17-22, and there were “standard scrambling techniques,” available to a POSITA, EX1054, 6:25-27; EX1002, ¶145. And LTE's frame and subframe design was well known by October 17, 2017 and had been “commercially deployed in LTE systems, thus showing that a POSITA would have reasonably expected to succeed in implementing the framing from LTE in connection with Galda's uplink.” EX1002, ¶146. A POSITA would thus have had no difficulty utilizing TS36.211's scrambling technique with Galda. EX1002, ¶146.

2. *Claim 10*

Galda in view of TS36.211 renders obvious *scrambling a block of bits* (TS36.211's scrambler scrambling Galda's convolutionally encoded “input data stream” which is a block of bits that will be converted into n vectors $D_l^{(m)}$ (block

$D_{n,l}^{(m)}$ of “complex modulation symbols”) of one subframe of a physical uplink shared channel (TS36.211 scrambles blocks of bits to be “transmitted on the physical uplink shared channel in one subframe”) resulting in a block of scrambled bits (in TS36.211 a block of scrambled bits $\tilde{b}(0), \dots, \tilde{b}(M_{bit} - 1)$ and in Galda bits input into the modulator would be scrambled); and modulating the block of scrambled bits resulting in the block of complex-valued symbols (Galda’s n vectors $D_l^{(m)}$ also defined as $D_{n,l}^{(m)}$). EX1002, ¶¶147-53.

Galda discloses convolutionally encoding an “input data stream” for each user (m), before mapping the resulting bit sequence onto L complex modulation symbols. EX1004, p.1738. TS36.211 shows scrambling before “Modulation mapper”:

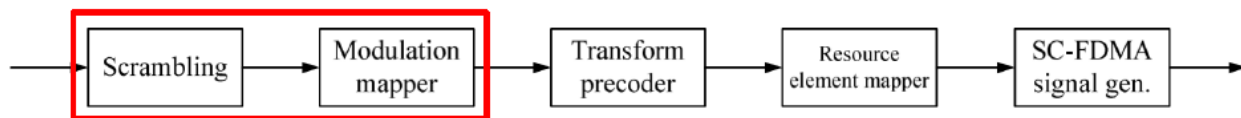


Figure 5.3-1: Overview of uplink physical channel processing.

EX1056, p.13. TS36.211 describes *scrambling a block of bits of one subframe of a physical uplink shared channel* because it says “[t]he block of bits $b(0), \dots, b(M_{bit} - 1)$, where M_{bit} is the number of bits transmitted on the physical uplink shared channel in one subframe shall be scrambled with a UE-specific scrambling sequence prior to modulation” EX1056, pp.15-16. This scrambling results *in a block of scrambled bits* because TS36.211 says it results “in a block of scrambled bits $\tilde{b}(0), \dots, \tilde{b}(M_{bit} - 1)$.” EX1056, p.14.

In the combination of Galda in view of TS36.211, Galda would then perform the step of *modulating the scrambled bits* because Galda's "user input data" scrambled according to TS36.211 is subjected to Galda's "coherent, higher-level modulation scheme" of Galda's modulator. EX1004, pp.1738-1740. This modulation results *in the block of complex-valued symbols*, i.e., Galda's $D_l^{(m)}, l = 0, \dots, L - 1$ as scrambled according to TS36.211. EX1002, ¶¶148-51.

It was obvious to modify Galda such to perform *scrambling a block of bits of one subframe of a physical uplink shared channel resulting in a block of scrambled bits* based on TS36.211 for the reasons explained above. *Supra* §VIII.C.1; EX1002, ¶152.

Thus, Galda in view of TS36.211 renders obvious claim 10.

3. Claim 11

Galda in view of TS36.211 renders obvious *wherein the scrambling is configured to scramble the block of bits into a block of scrambled bits with at least one pseudo-noise code*. EX1002, ¶¶154-56. TS36.211 describes a "UE-specific scrambling sequence" that is defined as " $c(i)$," which is "given by Section 7.2." EX1056, p.14. Section 7.2 describes generating "pseudo-random sequences," which are also known as a "pseudo noise" or "PN" sequence. EX1056, pp.78-79; EX1002, ¶155. It was obvious to modify Galda to include scrambling with at least one pseudonoise code for the same reasons it was obvious to implement scrambling in

Galda, as discussed above. *Supra* §VIII.C.1.

Thus, Galda in view of TS36.211 renders obvious claim 11.

D. Ground 5: Claims 24-25, 29, 32, 44, and 47 are obvious over Galda in view of Dowling

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

Claims 24-26, 29, 32, and 44 requires “a processor” [24A] and “a non-transitory computer-readable memory communicatively coupled to the processor, the memory including a set of instructions stored thereon and executable by the processor” to perform subsequent steps [24B]. Claim 47 similarly requires “a computer program product, comprising a non-transitory computer readable hardware storage device having computer readable program code stored therein, said program code containing instructions executable by one or more processors of a computer system to implement a method” [47Pre]. Otherwise, except for claim 32, these claims correspond to claims 1-2, 6, and 20.

Galda does not state whether the disclosed techniques are implemented in hardware or a combination of hardware and software. EX1002, ¶¶157-59. A POSITA would have found it obvious to implement Galda in software stored in memory coupled to a processor such that the software is executed by the processor. EX1002, ¶159.

A POSITA knew that transmitters may be implemented in hardware or

software. 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 some form of memory, and is provided to a processor for execution as was well known to a POSITA. EX1002, ¶¶160-61. A POSITA knew 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, ¶¶160-61; EX1008 (describing OFDM-CDMA software radio); EX1011, ¶¶[0124]-[0125] (modulation “and other techniques” can be implemented in “hardware, software, or a combination thereof.”).

A POSITA would have been motivated to implement Galda’s spreading, mapping, modulation, and cyclic prefix appending functions (among others) 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, ¶162.

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* §VIII.A; EX1002, ¶163. Implementing these mathematical operations in software would have required only routine knowledge because software is especially well-suited for performing mathematical operations. EX1002, ¶163. Given the disclosures indicating that those in the field were aware that various transmitter functions were implemented in either hardware or software—two known alternatives—a POSITA would have reasonably expected success in achieving a software implementation using instructions stored on a memory for execution by a processor. *Id.*

2. *Claims 24 and 47*

a. [24Pre]: Apparatus:

Galda discloses and renders obvious “*an apparatus.*” EX1004, pp.1737-38,

1740 (Figs. 1, 4, 6); EX1002, ¶¶164-65.

- b. [24A] processor; [24B]: memory; [47Pre]: computer program product including storage with code including processor-executable instructions

Galda in view of Dowling discloses and renders obvious the following aspects of claims 24 and 47:

[24A] a processor; [24B] a non-transitory memory coupled to the processor, the non-transitory memory including a set of instructions stored therein and executable by the processor for performing claim 24's functions;

[47Pre] A computer program product, comprising a non-transitory computer readable hardware storage device having computer readable program code stored therein, said program code containing instructions executable by one or more processors of a computer system to implement a method

EX1002, ¶¶166-70.

Dowling explains that OFDM 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 (*program code containing*

instructions) is stored in *memory* (a computer readable hardware storage device) and is provided from memory (*storage device*) to a *processor* for *execution*. EX1002, ¶¶167-68. A POSITA knew about “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, ¶169; EX1008; 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 Galda in software stored on memory for execution by a processor coupled to the memory as recited in claim 24. *Supra* §VIII.D.1.

Thus, Galda in view of Dowling discloses and renders obvious limitations [24A]-[24B] and preamble [47pre].

c. [24Ci], [47A]: dividing into sets

As explained in connection with limitation [1A], Galda discloses and renders obvious *dividing a block of complex-valued symbols into a plurality of sets of complex-valued symbols* [24Ci], [47A]. EX1002, ¶171; *supra* §VIII.A.1.b.

d. [24Cii], [47B]: transform precoding

As explained in connection with Limitation [1B], Galda discloses and renders obvious *transform precoding each of the plurality of sets of complex-valued symbols into a block of transform precoded complex-valued symbols* [24Cii], [47B].

EX1002, ¶172; *supra* §VIII.A.1.c.

e. [24Ciii], [47C]: generating OFDM signal

As explained in connection with Limitation [1C], Galda discloses and renders obvious *generating an Orthogonal Frequency Division Multiplex (OFDM) signal comprising a plurality of OFDM subcarriers modulated with the transform-precoded complex-valued symbols* [24Ciii], [47C]. EX1002, ¶173; *supra* §VIII.A.1.d.

f. [24Civ], [47D]: reduced PAPR

As explained in connection with Limitation [1D], Galda discloses and renders obvious *wherein the transform precoding generates a plurality of orthogonal spreading codes to provide a superposition of the plurality of OFDM subcarriers with a reduced peak-to-average-power ratio* [24Civ], [47D]. EX1002, ¶¶174-75; *supra* §VIII.A.1.e.

Thus, Galda in view of Dowling renders obvious claims 24 and 47 for the reasons explained above.

3. *Claim 25*

As explained in the discussion of **claim 2**, Galda discloses and renders obvious *wherein the transform precoding spreads the block of complex-valued symbols with a plurality of orthogonal spreading codes comprising complex-valued coefficients of a discrete Fourier transform (DFT) to produce the block of transform-*

precoded complex-valued symbols. EX1002, ¶¶176-77; *supra* §VIII.A.2.

Thus, Galda in view of Dowling renders obvious claim 25 for the reasons explained above.

4. *Claim 29*

As explained in the discussion of **claim 6**, Galda discloses and renders obvious *mapping the block of transform-precoded complex-valued symbols to physical resource blocks assigned for transmission of a physical uplink shared channel*. EX1002, ¶¶178-79; *supra* §VIII.A.3.

Thus, Galda in view of Dowling renders obvious claim 29.

5. *Claim 32*

Galda discloses and renders obvious *wherein the mapping is configured to select the plurality of OFDM subcarriers according to at least one of a frequency division multiple access scheme, a time division multiple access scheme, a space division multiple access scheme, a code division multiple access scheme, and a frequency-hopping scheme*. EX1002, ¶¶180-81. Specifically, Galda discloses selecting OFDM subcarriers *according to a frequency division multiple access scheme*. EX1002, ¶180; EX1004, p.1738 (Fig. 2) (disclosing FDMA-based subcarrier allocation scheme); pp.1739-40 (disclosing an OFDM-FDMA uplink transmitter that maps subcarriers according to an FDMA scheme).

Thus, Galda in view of Dowling renders obvious claim 29.

6. *Claim 44*

As explained in the discussion of **claim 20**, Galda discloses and renders obvious *wherein each of the plurality of sets of complex-valued symbols is a single carrier frequency division multiple access (SC-FDMA) symbol*. EX1002, ¶¶182-83; *supra* §VIII.A.4.

Thus, Galda in view of Dowling renders obvious claim 44.

E. Ground 6: Claim 26 is obvious over Galda in view of Dowling and further in view of Bury

Claim 26 depends from claim 25, which depends from claim 24. Galda in view of Dowling renders claims 24-25 obvious. Neither Galda nor Dowling disclose that the DFT is a FFT. As explained in the discussion of **claim 3**, Bury does. *Supra* §VIII.B. It was further obvious to modify Galda in view of Dowling as applied to claim 24, *supra* §VIII.C.1, such that the *DFT is a FFT* as taught by Bury for the same reasons discussed for **claim 3**. Implementing a FFT in software was routine and predictable because a FFT is a well-known algorithm. EX1002, ¶¶184-86; EX1052, p.23.

F. Ground 7: Claims 33-34 are obvious over Galda in view of Dowling and TS36.211

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

Petitioner previously explained why it was obvious to combine Galda with TS36.211 in Ground 4 and to combine Galda with Dowling in Ground 5. It was

obvious to implement Galda in view of TS36.211 in a processor performing instructions stored in memory per Dowling, as required by claims 33-34. EX1002, ¶¶187-89. A POSITA would have found it simple and predictable to scramble bits using TS36.211's known scrambling code because it would have merely employed mathematical techniques and TS36.211 already provides "pseudo code" for software scrambling. EX1056, p.14; EX1002, ¶188. Thus, implementing scrambling in software was routine, predictable, and within the level of skill of a POSITA. EX1002, ¶189. Therefore, it was obvious to implement the combination of Galda and TS36.211 in computer code stored in memory/storage and executable by a processor based on Dowling's teachings for the reasons explained further above. *Supra* §§VIII.C.1 (Ground 4; motivation); VIII.D.1 (Ground 5; motivation).

2. Claim 33

Galda in view of Dowling and TS36.211 renders obvious *instructions for: scrambling a block of bits of one subframe of a physical uplink shared channel resulting in a block of scrambled bits; and modulating the block of scrambled bits resulting in the block of complex-valued symbols*. EX1002, ¶¶190-92. Galda in view of TS36.211 renders performing this function obvious for the reasons discussed above regarding **claim 10**, *supra* §VIII.C.2, and it was obvious to perform this function based on the execution of computer code by a processor for the reasons explained above, *supra* §VIII.F.1.

Thus, Galda in view of Dowling and further in view of TS36.211 renders obvious claim 33.

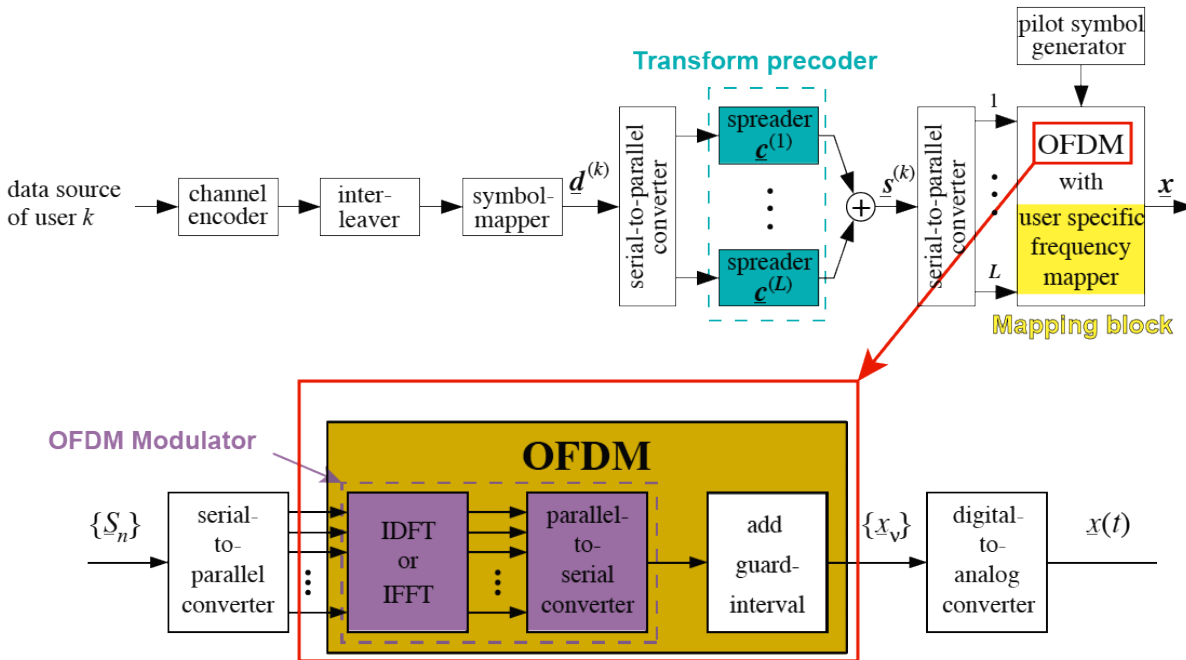
3. *Claim 34*

Galda in view of Dowling and TS36.211 renders obvious *wherein the scrambling is configured to scramble the block of bits into a block of scrambled bits with at least one pseudo-noise code*. EX1002, ¶¶193-95. Galda in view of TS36.211 renders performing this function obvious for the reasons discussed above regarding **claim 11**, *supra* §VIII.C.3, and it was obvious to perform this function based on the execution of computer code by a processor for the reasons explained above, *supra* §VIII.D.1. Thus, Galda in view of Dowling and further in view of TS36.211 renders obvious claim 34.

G. Ground 8: Claims 1-3, 6-7, 10-11, and 20 are obvious over Kaiser in view of Bury

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

Kaiser discloses most elements of the Challenged Claims. Kaiser illustrates a transform-precoding block for spreading data symbols, a mapping block for mapping data symbols to subcarrier frequencies, an OFDM modulator for modulating those symbols onto their assigned subcarrier frequencies to generate an OFDM signal:

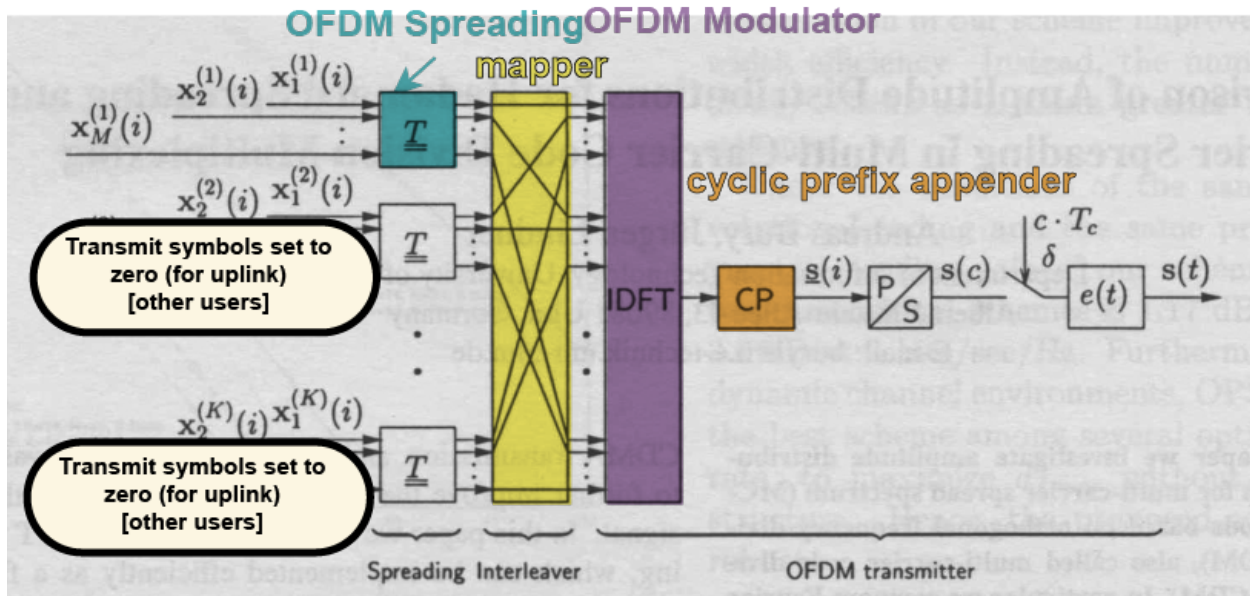


EX1005 pp.34, 132 (Fig. B.2 & Fig. 3.2 (combined)); EX1002, ¶196. “OFDM with guard interval is applied in SS-MC-MA systems”—like that shown in Kaiser Figure B.2—“in the same way as in MC-CDMA systems, cf. Section 3.1.1.” EX1005, p.133. Thus, a POSITA would have understood that Figure B.2’s “OFDM” has the functional blocks shown in §3.1.1, Figure 3.2. EX1002, ¶197.

Kaiser’s OFDM transmitter spreads data symbols with Walsh-Hadamard spreading and not the claimed “complex-valued symbols.” EX1005, p.135 (“block of ... data symbols is ... spread with orthogonal Walsh Hadamard codes ...”); *id.*, p.134 (Table B.1, “spreading code”).

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. In Bury’s uplink transmitter one user “K” has non-zero symbol values and all other transmit symbols are set to zero “thereby omitting the corresponding signal paths” for the uplink as shown below.



EX1007, p.858 (Fig. 1).

“Walsh-Hadamard spreading” is “commonly used” in MC-CDMA systems. EX1007, p.857. This is true of Kaiser. Bury evaluated whether there were better spreading codes. Bury concluded that using “Fourier spreading” with a “discrete Fourier transform (DFT) operation” materially improved PAPR performance over Walsh-Hadamard codes. *Id.* 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. “[I]n 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.*

Based on these teachings, a POSITA would have been motivated to use Bury's complex-valued DFT-spreading instead of Kaiser's Walsh-Hadamard codes for precoding Kaiser's uplink OFDM transmissions. EX1002, ¶¶198-204. Not only do Kaiser and Bury discuss the same types of OFDM transmission systems (MC-FDMA (Bury) or MC-SS-MA (Kaiser), EX1007, p.857), but Bury concluded that complex-valued DFT-spreading (thus precoding the symbols) was "the best choice" for uplink communications. EX1002, ¶¶203-04. Bury thus provides an explicit motivation to use complex-valued spreading codes (codes from a DFT matrix) for precoding (spreading) data symbols instead of Kaiser's Walsh-Hadamard codes.

Combining Kaiser and Bury would have 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.

A POSITA would have reasonably expected to succeed in using Bury's complex-valued spreading codes for precoding 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, ¶¶204-07.

2. *Claim 1*

a. **[1Pre]**

[1Pre] is a generic non-limiting preamble. Kaiser in view of Bury renders obvious the steps of claim 1. EX1002, ¶¶208-09.

b. **[1A]: dividing into sets**

Kaiser in view of Bury renders obvious dividing a block of complex-valued symbols into a plurality of sets of complex-valued symbols. EX1002, ¶¶210-19.

Kaiser discloses:

In SS-MC-MA systems, L subsequent complex-valued data symbols $\underline{d}_l^{(k)}, l = 1 \dots L$, of user k are serial-to-parallel converted. The vector

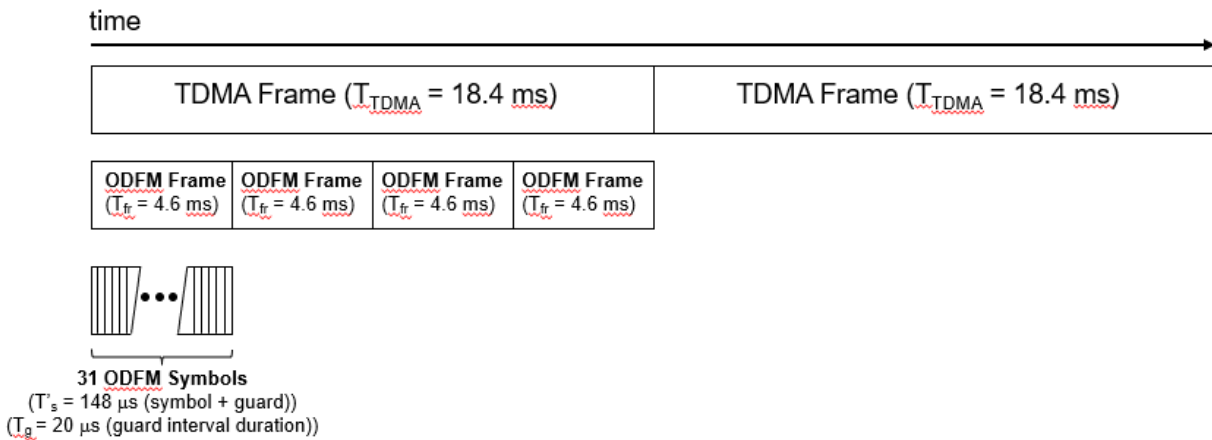
$$\underline{d}^{(k)} = \left(\underline{d}_1^{(k)}, \underline{d}_2^{(k)}, \dots, \underline{d}_L^{(k)} \right)^T \quad (B.1)$$

represents one block of L parallel converted data symbols of the k th user.

EX1005, pp.131-32. Kaiser's vector $\underline{d}^{(k)}$ represents a *set of complex-valued symbols* as recited in claim 1. EX1002, ¶¶210-12.

Kaiser does not use the time index in its mathematics, but a POSITA would

have understood them to be disclosed by, or at least obvious over, Kaiser's teachings. EX1005, p.31 ("For brevity ... the transmission of a single but arbitrary sequence $\{S_n\}$ is considered in this chapter, so that no additional time index is required."). EX1002, ¶213. A POSITA would thus have understood that Kaiser's system operated on multiple vectors $\underline{d}^{(k)}$ over time. EX1002, ¶213. First, a POSITA would have understood that Kaiser's exemplary SS-MC-MA system included TDMA frames and OFDM subframes (with 31 OFDM symbols). EX1005, p.134; EX1002, ¶214. Kaiser has the framing structure illustrated below based on Kaiser's Table B.1:



EX1005, p.134; EX1002, ¶214. A single OFDM transmission symbol plus guard interval is $148 \text{ } \mu\text{s}$. EX1005, p.134. While not illustrate above, OFDM symbols are allocated to L assigned subcarriers. Kaiser's mapping block maps spread data symbols ($L=8$ of $N_C=256$ subcarriers) to L subcarriers. EX1005, p.132 ("mapping assigns each subsystem, and hence, each user exclusively to its L subcarriers"). Kaiser shows mapping spread data symbols to $L=8$ subcarriers (of $N_C=256$ available

subcarriers) below.

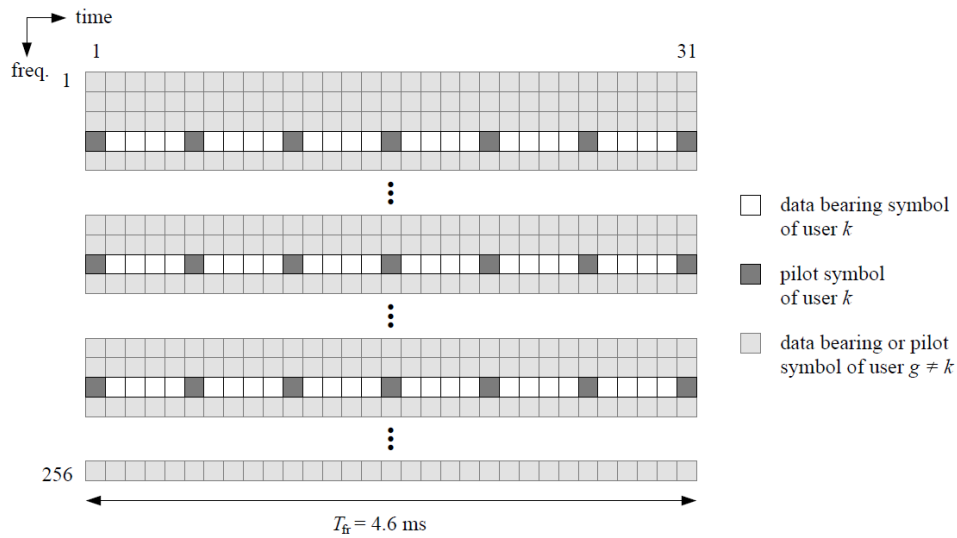


Figure B.4: OFDM frame of the proposed SS-MC-MA mobile radio system; $N_c = 256$; $N_s = 31$; $N_t = 5$; $N_{\text{grid}} = 1792$

Id., pp.134-135 (Fig. B.4). Here, spread data symbols ($\underline{s}^{(k)} = (\underline{s}_1^{(k)}, \underline{s}_2^{(k)} \dots \underline{s}_L^{(k)})$) are mapped to the subcarriers over the OFDM subframe. EX1005, p.132; EX1002, ¶¶215-16. These spread data symbols are produced by multiplying vector $\underline{d}^{(k)}$ (a *set of complex-valued symbols*) by a spreading matrix $\underline{C}$. EX1005, p.132. Thus, a POSITA would have understood that for each OFDM symbol, the process of multiplying vector $\underline{d}^{(k)}$ (a *set of complex-valued symbols*) by matrix $\underline{C}$ is repeated over and over, thus filling up the “OFDM frame” (i.e., a subframe of the TDMA frame). EX1002, ¶¶217-18. A POSITA thus would have understood Kaiser to disclose that time index 1 to 31 in Figure B.4 defines each of the possible *sets of complex-valued symbols* that are divided from a block of complex-valued symbols

(e.g., 24⁴ columns of vectors $\underline{d}^{(k)} = (\underline{d}_1^{(k)}, \underline{d}_2^{(k)}, \dots, \underline{d}_L^{(k)})^T$ including “complex-valued data symbols,” EX1005, p.132) thus defining the data that is inserted into an OFDM frame of 31 symbols. EX1002, ¶218. At the very least, *dividing a block of complex-valued symbols* into column vectors ($\underline{d}^{(k)}$) to create *a plurality of sets of complex-valued symbols* was obvious based on these teachings.

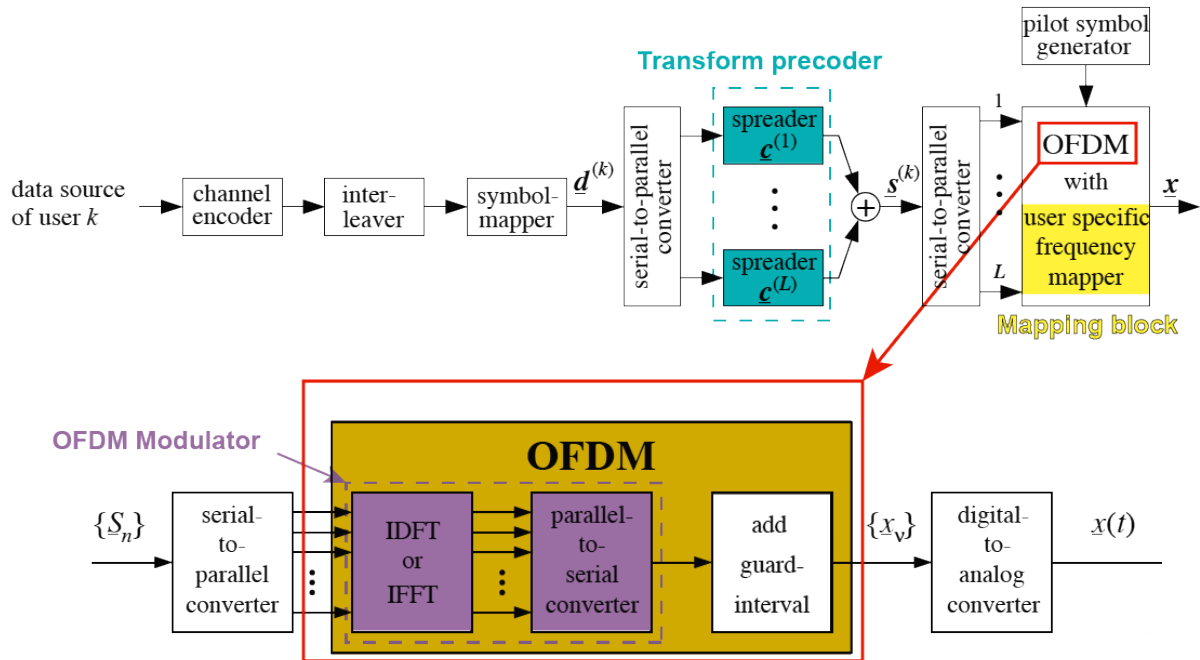
Thus, Kaiser discloses or renders obvious Limitation [1A].

c. [1B]: transform precoding

Kaiser in view of Bury renders obvious *transform precoding* (by spreading using Bury’s DFT spreading) *each of the plurality of sets of complex-valued symbols* (Kaiser’s “complex-valued symbols” $\underline{d}^{(k)}$) *into a block of transform-precoded complex-valued symbols* (into multiple sets of DFT spread symbols $\underline{s}^{(k)} = \underline{C} \underline{d}^{(k)} = (\underline{s}_1^{(k)}, \underline{s}_2^{(k)}, \dots, \underline{s}_L^{(k)})^T$ using Bury’s DFT spreading matrix). EX1002, ¶¶220-225.

Kaiser discloses a *transform precoder* that precodes *each of the plurality of sets of complex-valued symbols* $\underline{d}^{(k)}$ into a block of spread (transform-precoded) complex-valued symbols:

⁴ Kaiser interleaves 7 pilot symbols among the 24 data symbols for a total of 31 symbols. EX1005, p.135.



EX1005, pp.34, 132 (Figs. B.2 & 3.2). The spreading operation uses an $L \times L$ matrix ($\underline{C}$) and multiplies it by the vector of complex-valued symbols $\underline{d}^{(k)}$:

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

EX1005, pp.131-32; *see id.*, pp.130-31, 133-35.

Kaiser uses Walsh-Hadamard spreading for precoding. EX1005, pp.134-135. Bury discloses that DFT-spreading is superior to Walsh-Hadamard spreading (especially with larger spreading factors) and encourages its use to reduce PAPR. EX1007, p.860; *supra* §VIII.G.1. Bury explains that “[s]preading is done by transforming a vector of M symbols through a matrix $\underline{T}$.” EX1007, pp.857-58. Therefore, insofar as *transform precoding* includes precoding with DFT coefficients or a DFT matrix, a POSITA would have been motivated and found it obvious to

transform-encode each set of data symbols $\underline{d}^{(k)}$ with Fourier coefficients via a DFT spreading matrix C to produce DFT-spread symbols $\underline{s}^{(k)} = (\underline{s}_1^{(k)}, \underline{s}_2^{(k)}, \dots, \underline{s}_L^{(k)})^T$ for the reasons explained above. *Supra* §VIII.G.1; EX1005, pp.131-32; EX1007, p.860; EX1002, ¶¶220-224.⁵

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

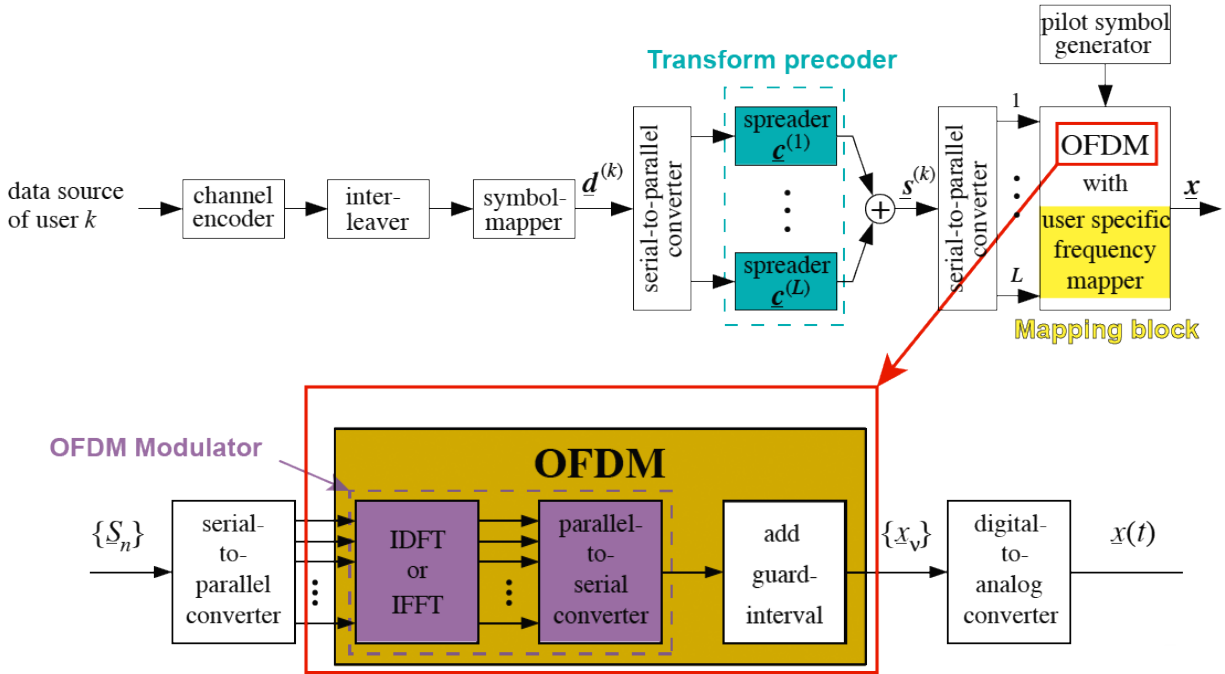
d. [1C]: generating an OFDM signal

Kaiser in view of Bury renders obvious *generating an Orthogonal Frequency Division Multiplex (OFDM) signal* (Kaiser's transmission signal $\underline{x}$) *comprising a plurality of OFDM subcarriers modulated by the transform-encoded complex-valued symbols* (L subcarriers are modulated by the Kaiser-Bury transform-encoded complex-valued transmission vector $\underline{s}^{(k)} = (\underline{s}_1^{(k)}, \underline{s}_2^{(k)}, \dots, \underline{s}_L^{(k)})^T$). EX1002, ¶¶226-30.

Kaiser shows an IDFT/IFFT OFDM modulator block that generates *an Orthogonal Frequency Division Multiplex (OFDM) signal* at the output of the

⁵ In the remainder of the discussion of the Kaiser-based Grounds, Petitioner refers to refers to DFT-spread symbols/signals in view of the Kaiser-Bury combination (i.e., replacing Kaiser's Walsh-Hadamard coefficients with Bury's DFT coefficients).

OFDM block (labeled $\underline{x}$ in Fig. B.2 and $\underline{x}(t)$ in Fig. 3.2).



EX1005, pp.34, 132 (Figs. B.2 & 3.2); EX1002, ¶¶226-27 (output of Kaiser’s OFDM transmitter is a transmission signal labeled “ $\underline{x}$ ”). Kaiser’s OFDM signal comprises a plurality of OFDM subcarriers modulated by the transform-precoded complex-valued symbols because Kaiser explains a “transmission vector” $\underline{s}^{(k)} = (\underline{s}_1^{(k)}, \underline{s}_2^{(k)}, \dots, \underline{s}_L^{(k)})^T$ “consisting of L components” is generated by multiplying “complex-valued data symbols $\underline{d}_l^{(k)}, l = 1 \dots L$ ” with Bury’s complex-valued DFT spreading codes, thus generating a “transmission vector” $\underline{s}^{(k)} = (\underline{s}_1^{(k)}, \underline{s}_2^{(k)}, \dots, \underline{s}_L^{(k)})^T$ “consisting of L components.” EX1005, p.132. The elements of transmission vector $\underline{s}^{(k)}$ are the transform-precoded complex-valued symbols.

EX1002, ¶228.

Kaiser's OFDM signal comprises *a plurality of OFDM subcarriers modulated by $\underline{s}^{(k)}$* because Kaiser says each user is assigned L subcarriers and the L components of the vector $\underline{s}^{(k)}$ are mapped to the L subcarriers, thus allowing for exploitation of “frequency diversity by spreading each data symbol over L subcarriers.” EX1005, p.131; EX1002, ¶229.

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

e. [1D]: reduced PAPR

Kaiser in view of Bury renders obvious *wherein the transform precoding generates a plurality of orthogonal spreading codes* (Bury's DFT spreading codes) *to provide a superposition of the plurality of OFDM subcarriers with a reduced peak-to-average-power ratio* (the OFDM signal is a superposition and by using Bury's DFT spreading codes, PAPR is reduced). EX1002, ¶¶231-36.

Kaiser's OFDM signal is *a superposition of the plurality of OFDM subcarriers* because Kaiser explains that:

[a] key advantage of using OFDM is that the MC [(multi-carrier)] modulation can be implemented in the discrete domain using an IDFT, or a more computationally efficient IFFT. [] When sampling the complex envelope $x(t)$ of an OFDM symbol at time instances t equal to $(v=1, \dots, N_C)$, the samples are

$$\underline{x}_v = \frac{1}{\sqrt{N_C}} \sum_{n=1}^{N_C} \underline{s}_n e^{j2\pi(n-1)(v-1)/N_C}, v = 1, \dots, N_C \quad (3.6)$$

and the sampling rate is N_C/T_s . The important result is that the sampled sequence $\{\underline{x}_v\}$, $v = 1, \dots, N_C$, is the IDFT of the source symbol sequence $\{\underline{s}_n\}$, $n = 1, \dots, N_C$.

EX1005, p.32. Patent Owner has admitted that a POSITA “would understand that an OFDM signal is a superposition of subcarriers.” EX1039, p.10. And, “[i]f multiple symbols are input to the IFFT at the same time, the output discrete-time signal is a sum (i.e., a superposition) of the subcarriers modulated with their corresponding symbols.” *Id.* Thus, Kaiser’s disclosure of inputting multiple (spread) symbols $\{\underline{s}_n\}$ (or $\underline{s}^{(k)}$, depending on the figure) into an IFFT, *see, e.g.*, EX1005, p.34 (Fig. 3.2), results in an OFDM signal that is a superposition of the subcarriers modulated with their corresponding symbols. EX1002, ¶¶232-34; EX1039, p.10; EX1005, pp.32, 34, 132-133.

In the Kaiser-Bury combination, *transform precoding generates a plurality of orthogonal spreading codes* that result in the superposition having a *reduced peak-to-average-power ratio*. As noted above, Bury’s DFT-spreading reduces PAPR in multi-carrier FDMA uplink transmissions as compared to Walsh-Hadamard spreading. *Supra* §VIII.G.1; EX1007, pp.860 (“For Fourier spreading ... the PAPR remains nearly constant at a low level for all spreading factors.... [I]n the uplink Fourier spreading outperforms Hadamard spreading in most cases.”); *see also id.*

(“Fourier spreading delivers a lower or equal PAPR” with a “superiority” that “increases significantly for larger spreading factors.”); EX1002, ¶235; *Supra* §VIII.G.1.

Thus, Kaiser in view of Bury renders obvious claim 1.

3. *Claim 2*

As explained in connection with Limitation [1B], Kaiser in view of Bury renders obvious *wherein the transform precoding spreads the block of complex-valued symbols with a plurality of orthogonal spreading codes comprising complex-valued coefficients of a discrete Fourier transform (DFT) to produce the block of transform-precoded complex-valued symbols. Supra §§VIII.G.1, VIII.G.2.c; EX1002, ¶¶237-38.*

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

4. *Claim 3*

Kaiser in view of Bury renders obvious *wherein the DFT is a fast Fourier transform (FFT).* EX1002, ¶¶239-40.

Kaiser in view of Bury renders obvious a DFT for spreading and Bury further says to “employ a DFT for spreading, which can be implemented efficiently as a fast Fourier transform (FFT).” EX1007, p.857. Therefore, a POSITA would have found it obvious to use the FFT implementation disclosed by Bury because of its computational efficiency to generate the complex-valued spreading codes to spread

Kaiser's complex-valued data symbols. EX1002, ¶239; *supra* §VIII.G.1.

Thus, Kaiser in view of Bury renders obvious claim 3.

5. *Claim 6*

Kaiser in view of Bury renders obvious *mapping the block of transform-precoded complex-valued symbols* (block of 31 columns of vectors $\underline{d}^{(k)} = (d_1^{(k)}, d_2^{(k)}, \dots, d_L^{(k)})^T$) to physical resource blocks assigned for transmission of a physical uplink shared channel (to time-frequency blocks for L subcarriers within an OFDM frame to be transmitted over a channel defined by N_C and shared by K users.). EX1002, ¶¶241-46.

Kaiser describes or at least renders obvious *mapping the block of transform precoded complex-valued symbols* (e.g., the 24 column vectors $\underline{d}^{(k)}$ as discussed *supra* §VIII.G.2.b (Limitation [1A])) because Kaiser explains that “the SS-MC-MA 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. This mapping “assigns ... each user exclusively its L subcarriers....” *Id.* Kaiser includes an example in which a user's data symbols are mapped to $L=8$ subcarriers (out of an available $N_C=256$ total subcarriers). *Id.*, pp.134-135 (“Each user exclusively transmits on 8 subcarriers, where 3 of the 8 subcarriers used by the k th user are depicted.... [P]er user, a block of 8 serial data

symbols is parallel converted and spread with orthogonal Walsh Hadamard codes of length L equal to 8, resulting after superposition in the transmission sequence $\underline{s}^{(k)}$, cf. (B.3). Per OFDM symbol, 8 randomly interleaved components are mapped on 8 subcarriers exclusively used by the k th user.”); EX1002, ¶¶242-43.

Kaiser’s mapping maps *to physical resource blocks* as shown in Figure B.4, which shows “3 of the 8 subcarriers used by the k th user.”

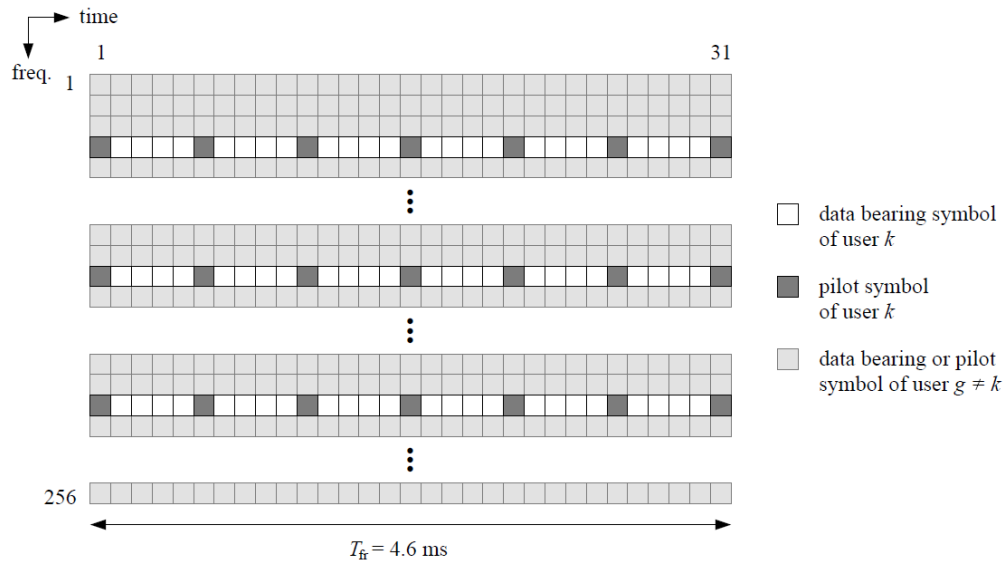


Figure B.4: OFDM frame of the proposed SS-MC-MA mobile radio system; $N_c = 256$; $N_s = 31$; $N_t = 5$; $N_{\text{grid}} = 1792$

EX1005, pp.134-135; EX1002, ¶244. Each white block is a *physical resource block* because it represents an instant in time on a specific subcarrier frequency. EX1002, ¶244. And, symbols from 24 column vectors $\underline{d}^{(k)}$ (*the block of transform precoded complex-valued symbols*) are mapped to these physical resource blocks as shown in Kaiser’s Figure B.4. EX1005, p.135; EX1002, ¶244. The physical resource blocks

are *assigned for transmission* because “[t]he user specific frequency mapping assigns ... each user exclusively its L subcarriers.” EX1005, p.132; EX1002, ¶245. Finally, the resource blocks are *of a physical uplink shared channel* because the L subcarriers are only a fraction of the total subcarriers, which are shared among users. EX1005, pp.134-135 (each k th user is assigned 8 subcarriers from $N_C=256$ total subcarriers); EX1002, ¶245.

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

6. *Claim 7*

Kaiser in view of Bury renders obvious *wherein the mapping is responsive to an assignment of spectrum resources for selecting a plurality of OFDM subcarriers corresponding to at least one OFDM symbol interval*. EX1002, ¶¶247-48.

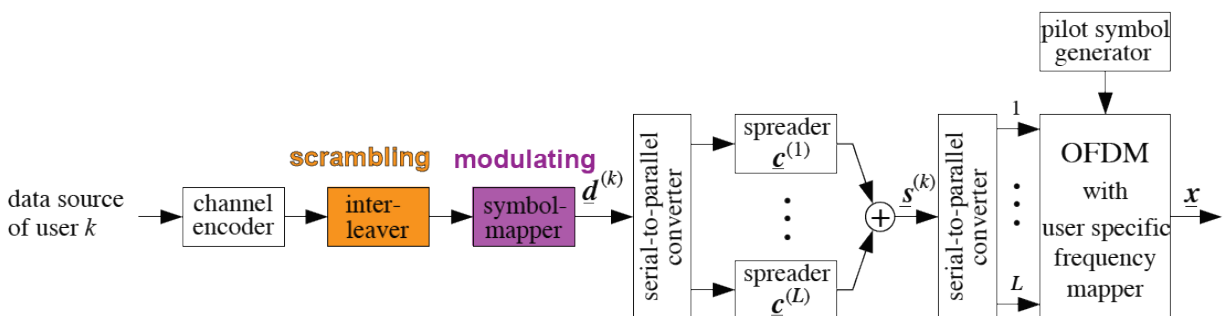
Kaiser describes *mapping that is responsive to an assignment of spectrum resources* because “[t]he user specific frequency mapping assigns ... each user exclusively its L subcarriers.” EX1005, p.132. The subcarriers are spectrum resources for *selecting a plurality of OFDM subcarriers* (i.e., L subcarriers) that *correspond to at least one OFDM symbol interval* (e.g., Kaiser’s Figure B.4 shows one OFDM frame with 31 symbol intervals and 3 of the 8 assigned subcarriers, EX1005, p.135; EX1002, ¶247).

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

7. *Claims 10 and 11*

Kaiser in view of Bury renders obvious *scrambling a block of bits* (bits from “data source of user k ” are scrambled by Kaiser’s interleaver) *of one subframe of a physical uplink shared channel* (of one OFDM frame, which is a subframe of Kaiser’s TDMA frame) *resulting in a block of scrambled bits* (resulting in scrambled bits input into “symbol mapper”) and *modulating the block of scrambled bits resulting in the block of complex-valued symbols* (symbol mapper uses “QPSK with Gray encoding” to modulate symbols). EX1002, ¶¶249-56. Kaiser in view of Bury also renders obvious *scrambling the block of bits into a block of scrambled bits with at least one pseudo-noise code*. *Id.*, ¶¶257-58.

Kaiser shows:



EX1005, p.132. Kaiser’s interleaver is for *scrambling a block of bits* because Kaiser explains that “[b]locks of L_a equal to 192 source bits are transmitted” and “[a]t the output of channel encoder, the code bits are scrambled in a random interleaver of size I_c equal to 384.” EX1005, p.76; *see also id.*, p.134 (“proposed SS-MC-MA”

system includes “code bit interleaver size of” $I_c=384$).⁶ Thus, Kaiser scrambles a block of bits of L_a (i.e., “length of the source bit vector”) which is shown as the “data source of user k ” with random interleaver. EX1005, pp.132, 135, 139; EX1002, ¶¶250-52.

The block of bits is *of one subframe of a physical uplink shared channel* because Kaiser describes a framing structure where 4 OFDM frames (*subframes*) of 31 symbols each (24 data symbols) are packed into one TDMA frame for each user before transmission over the channel defined by all subcarriers N_C shared among the users K . EX1005, pp.132 (describing “user specific frequency mapping” to “ L subcarriers”), 134 (system parameters including $L=8$, $N_C=256$); 135 (“The used TDMA frame structure consisting of 4 time slots. A time slot corresponds to an OFDM frame consisting of 31 OFDM symbols.”); EX1002, ¶253.

Kaiser’s scrambling results in *a block of scrambled bits* or at least such a block was obvious because (1) the input into interleaver/scrambler is “[b]locks of L_a equal to 192 source bits,” (2) the interleaver/scrambler has a size of 384, called “block size of 384,” and (3) a POSITA would have understood that the result of interleaving two blocks of bits was a block of scrambled bits, EX1002, ¶254; EX1005, pp.76, 134.

⁶ Kaiser’s interleaving and symbol mapping are “identical to those described in Chapter 4....” EX1005, p.132.

At the very least such block was the obvious output of Kaiser's scrambling. EX1002, ¶254.

Kaiser also describes *modulating the block of scrambled bits resulting in the block of complex-valued symbols* because it explains that "symbol mapper" takes as an input blocks of bits and maps them to an alphabet using QPSK with Gray encoding, which is a type of modulation. EX1005, pp.65 (describing "interleaved code bit vector" being "passed to a symbol mapper" where it is "mapped onto a complex-valued sequence of L_d data symbols taken from [a] complex data symbol alphabet"). 134 ("data symbol mapping" uses "QPSK with Gray encoding"); EX1002, ¶255. As shown above, the output of "symbol mapper" is "complex-valued data symbols $\underline{d}_l^{(k)}, l = 1 \dots L$, of user k ." EX1005, p.132. Thus, Kaiser in view of Bury renders obvious **claim 10**.

Kaiser also explains that the "code bit interleaver" of size 384 is a "pseudo random interleaver," EX1005, p.134, thus describing *scrambling the block of bits into a block of scrambled bits with at least one pseudo-noise code* as recited in **claim 11** because a "pseudo random code" is a "pseudo noise code." EX1002, ¶¶257-58.

8. *Claim 20*

Kaiser in view of Bury renders obvious *wherein each of the plurality of sets of complex-valued symbols is a single carrier frequency division multiple access (SC-FDMA) symbol*. EX1002, ¶¶259-62.

The Kaiser-Bury combination would have used DFT-spreading to improve PAPR. EX1002, ¶¶260-61. A consequence of using Bury’s DFT spreading is that the resulting symbols exhibit “the PAPR of a single carrier transmission when spreading is done over *all* subcarriers.” EX1007, p.860. A POSITA would have understood that the consequence of Bury’s DFT spreading was to produce a multicarrier system that is “technically equivalent to a single-carrier system with guard interval.” EX1016, p.2329 (DFT spreading results in a “pure single-carrier system”); EX1002, ¶261. At the very least, the consequences of using Bury’s DFT spreading and the resulting generation of *a single carrier frequency division multiple access (SC-FDMA) symbol* was obvious to a POSITA because DFT spreading was known to result in the generation of such symbols. EX1002, ¶261 (discussing EX1016, which is cited in Bury, *see* EX1007, p.860 (reference [4])).

Thus, Kaiser in view of Bury renders obvious claim 20.

H. Ground 9: Claims 24-26, 29, 32, 44, and 47 are obvious over Kaiser in view of Dowling and Bury

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

Claims 24-26, 29, 32-34, 44, and 47 require processors, memory (hardware storage) and a set of instructions or “program code containing instructions” that are executed by the processor to perform specific tasks. *See* Limitations [24A], [24B], and Preamble [47Pre]. *Supra* §§VIII.D-F. Otherwise, these claims correspond to

claims 1-3, 6, 10-11, and 20.

Kaiser suggests that at least some of the transmitter structure is implemented in hardware. EX1005, p.137. Bury is silent on the matter. It was obvious to implement the combined Kaiser-Bury OFDM transmitter (as discussed in connection with Ground 8, *supra* §VIII.G.1) in computer instructions stored in memory (e.g., software) that are executed by a processor coupled to the memory based on Dowling.

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; 21:62-64. A POSITA knew that software radios were available and had certain advantages over hardware implementations as discussed above. *Supra* §VIII.D.1 (Ground 5).

A POSITA would have been motivated to implement the Kaiser-Bury transmitter including functions of spreading, mapping, modulation, and cyclic prefix appending functions (among others) in a software radio for the same reasons a POSITA would have found implementing Galda’s analogous functions in software to be obvious. EX1002, ¶¶263-67; *Supra* §VIII.D.1.

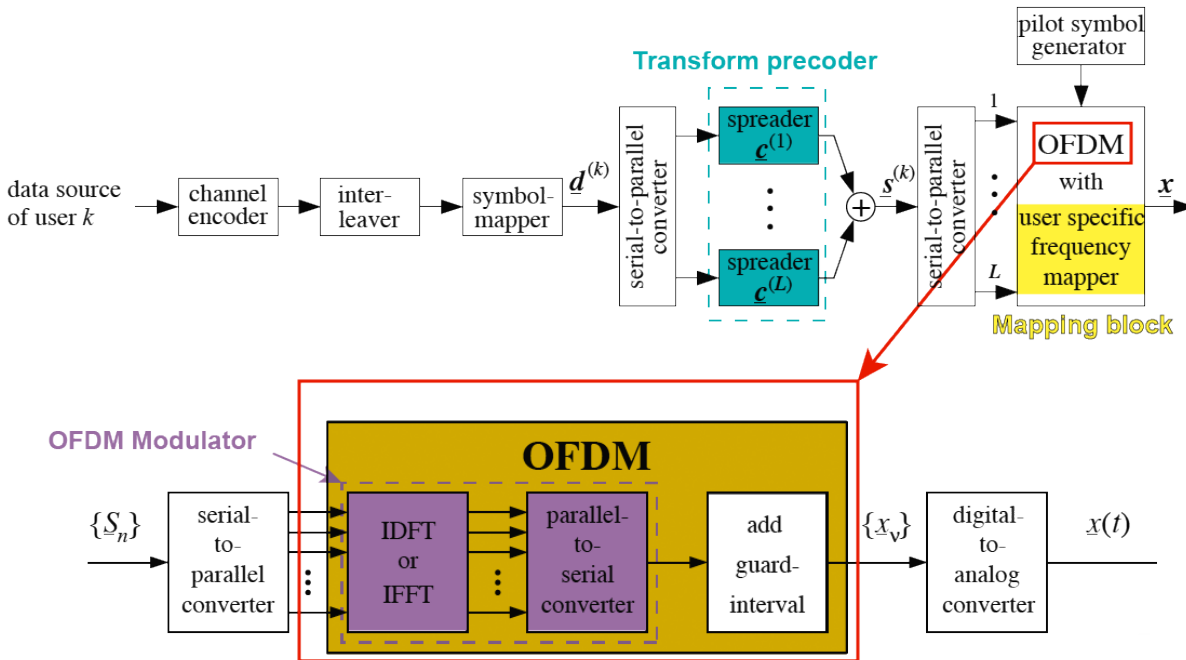
A POSITA also would have expected to succeed in making this combination. Kaiser discloses an OFDM transmitter and defines the various mathematical

operations for each of the components. *Supra* §§VIII.G.1-8; EX1002, ¶269. Implementing the required mathematical operations in software would have needed only routine knowledge because software is especially well-suited for performing mathematical operations (e.g., DFT spreading, performing an IFFT, etc.). EX1002, ¶269. Given the number of disclosures indicating that those in the field knew 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. *Id.*

2. *Claims 24 and 47*

a. [24Pre]: Apparatus

This is not a limiting preamble. Nevertheless, Kaiser describes an apparatus shown below:



EX1005, pp.34, 132 (Figs. 3.2 & B.2); EX1002, ¶¶270-71.

- b. [24A]: processor; [24B]: memory; [47pre] computer program product including storage with code including processor-executable instructions

Kaiser and Bury do not explicitly describe the claimed processor or memory. Dowling discloses and renders obvious *a processor [24A], a non-transitory computer-readable memory communicatively coupled to the processor, the memory including a set of instructions stored thereon and executable by the processor for [24B], or the computer program product as recited in [47pre]*. EX1002, ¶¶272-77.

Dowling explains that OFDM modulation techniques “may be implemented as software modules which execute on a programmable processor architecture.” EX1042, 3:46-50; *see id.*, 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 (*program code containing instructions*) is stored in *memory (a computer readable hardware storage device)* and is provided from memory (*storage device*) to a *processor for execution*. EX1002, ¶¶273-74. A POSITA knew about “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, ¶¶275; EX1008; 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 Galda in software stored on memory for execution by a processor coupled to the memory as recited in claims 24 and 47. *Supra* §VIII.D.1.

Thus, Kaiser in view of Dowling and Bury discloses and renders obvious limitations [24A]-[24B] and preamble [47pre].

c. [24Ci], [47A]: dividing into sets

As explained in connection with Limitation [1A], Kaiser in view of Bury renders obvious *dividing a block of complex-valued symbols into a plurality of sets of complex-valued symbols* [24Ci], [47A]. EX1002, ¶278; *supra* §VIII.G.2.b.

d. [24Cii], [47B] transform precoding

As explained in connection with Limitation [1B], Kaiser in view of Bury renders obvious *transform precoding each of the plurality of sets of complex-valued symbols into a block of transform precoded complex-valued symbols* [24Cii], [47B]. EX1002, ¶279; *supra* §VIII.G.2.c.

e. [24Ciii], [47C]: generating an OFDM signal

As explained in connection with Limitation [1C], Kaiser in view of Bury renders obvious *generating an Orthogonal Frequency Division Multiplex (OFDM) signal comprising a plurality of OFDM subcarriers modulated with the transform-precoded complex-valued symbols* [24Ciii], [47C]. EX1002, ¶280; *supra* §VIII.G.2.d.

f. [24Civ]: reduced PAPR

As explained in connection with Limitation [1D], Kaiser in view of Bury renders obvious *wherein the transform precoding generates a plurality of orthogonal spreading codes to provide a superposition of the plurality of OFDM subcarriers with a reduced peak-to-average-power ratio* [24Civ], [47D]. EX1002, ¶281; *supra* §VIII.G.2.e.

Thus, Kaiser in view of Dowling and Bury renders obvious claims 24 and 47 for the reasons explained above.

3. *Claim 25*

As explained in the discussion of **claim 2**, Kaiser in view of Bury renders obvious *wherein the transform precoding spreads the block of complex-valued symbols with a plurality of orthogonal spreading codes comprising complex-valued coefficients of a discrete Fourier transform (DFT) to produce the block of transform-precoded complex-valued symbols*. EX1002, ¶¶283-84; *supra* §VIII.G.3.

Thus, Galda in view of Dowling and Bury, as applied to claim 24 renders obvious claim 25.

4. *Claim 26*

As explained in the discussion of **claim 3**, Kaiser in view of Bury renders obvious *wherein the DFT is a fast Fourier transform (FFT)*. *Supra* §VIII.G.4; EX1002, ¶¶285-86. Thus, Kaiser in view of Dowling and Bury, as applied to claim 25 renders obvious claim 26.

5. *Claim 29*

As explained in the discussion of **claim 6**, Kaiser in view of Bury renders obvious *mapping the block of transform-precoded complex-valued symbols to physical resource blocks assigned for transmission of a physical uplink shared channel*. EX1002, ¶¶287-88; *supra* §VIII.G.5.

Thus, Kaiser in view of Dowling and Bury as applied to claim 24 renders obvious claim 29.

6. *Claim 32*

Kaiser in view of Dowling and Bury renders obvious *wherein the mapping is configured to select the plurality of OFDM subcarriers according to at least one of a frequency division multiple access scheme, a time division multiple access scheme, a space division multiple access scheme, a code division multiple access scheme, and a frequency-hopping scheme*. EX1002, ¶¶289-90. Specifically, Kaiser in view of Bury discloses a FDMA scheme by allocating a plurality of subcarriers exclusively to one user for transmission. EX1005, p.131 (“SS-MC-MA is an FDMA scheme on subcarrier level”); EX1002, ¶289.

Thus, Kaiser in view of Dowling and Bury renders obvious claim 32.

7. *Claims 33 and 34*

As explained in connection with **claim 10**, Kaiser in view of Bury renders obvious *scrambling a block of one subframe of a physical uplink shared channel resulting in a block of scrambled bits and modulating the block of scrambled bits resulting in the block of complex-valued symbols* (symbol mapper uses “QPSK with Gray encoding” to modulate symbols). EX1002, ¶¶291-92; *supra* §VIII.G.7. Thus, Kaiser in view of Dowling and Bury render obvious claim 33.

As explained in connection with **claim 11**, Kaiser in view of Bury also renders obvious *scrambling the block of bits into a block of scrambled bits with at least one pseudo-noise code*. EX1002, ¶¶293-94; *supra* §VIII.G.7.

8. *Claim 44*

As explained in the discussion of claim 20, Kaiser in view of Bury renders obvious *wherein each of the plurality of sets of complex-valued symbols is a single carrier frequency division multiple access (SC-FDMA) symbol*. EX1002, ¶¶295-96; *supra* §VIII.G.8.

Thus, Kaiser in view of Dowling and Bury renders obvious claim 44.

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. *Petitioner 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. EX1079. This is the first and only IPR on the ’568 Patent, so a patentability determination by the Board on this Petition would conserve resources.

B. Denial Under §325(d) Unwarranted

The '568 Patent was not rejected on any prior art, and the prior art in Petitioner's Grounds was never cited, much less discussed, during prosecution. 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 '568 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. 11,075,786:** *Samsung Electronics Co., Ltd. v.*

GenghisComm Holdings, LLC, IPR2025-00789; 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. 11,223,508:** *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 '568 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 1, 2025

Respectfully Submitted,

/Andrew R. Sommer/

Andrew R. Sommer
Reg. No. 53,932

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 13,972 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 1, 2025

Respectfully Submitted,

/Andrew R. Sommer/

Andrew R. Sommer
Reg. No. 53,932

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e) and 42.105(a), the undersigned certifies that on April 1, 2025, I caused a true and correct copy of **PETITION FOR *INTER PARTES* REVIEW OF CLAIMS 1-3, 6, 10-11, 20, 24-26, 29, 32-34, 44, 47 OF U.S. PATENT NO. 10,389,568 PETITIONER’S POWER OF ATTORNEY BY SAMSUNG ELECTRONICS CO., LTD., PETITIONER’S POWER OF ATTORNEY BY SAMSUNG ELECTRONICS AMERICA, INC., AND EXHIBITS 1001-1008, 1011-1012, 1016, 1021, 1023, 1028, 1030-1032, 1034, 1036-1040, 1042-1047, 1049, 1051-1065, 1071, and 1079** by EXPRESS MAIL on the Patent Owner at the correspondence address of record for U.S. Patent No. 10,389,568 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

/Andrew R. Sommer/

Andrew R. Sommer

Reg. No. 53,932