

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: IPR2025-00791
U.S. Patent No. 11,252,005

**PETITION FOR *INTER PARTES* REVIEW OF CLAIMS 1, 6, 7, 9, 10,
11, 13, 18, 19, 21, 22, 23, 25, 30, 31, 33, 34 AND 35 OF
U.S. PATENT NO. 11,252,005**

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LISTING OF CLAIMS

Claim 1. [1Pre] A method for communication in a wireless network, comprising:

[1A] producing a set of subcarrier values that equals a product of a complex-valued code matrix with a matrix of data symbols;

[1B] selecting a set of subcarriers assigned for use by a user device; and

[1C] modulating the subcarrier values onto the set of subcarriers to produce a plurality of modulated subcarriers; and

[1D] producing a time-domain waveform from a superposition of the plurality of modulated subcarriers, the time-domain waveform to be transmitted in the wireless network by the user device;

[1E] wherein producing the set of subcarrier values employs a plurality of complex-valued codes that shapes interference patterns of the superposition to produce a plurality of cyclic-shifted waveforms that each have one of the data symbols modulated thereon.

Claim 6. The method of claim 1, wherein modulating and producing the time-domain waveform is performed using an inverse discrete Fourier transform.

Claim 7. The method of claim 1, wherein selecting the set of subcarriers comprises selecting one of a plurality of selectable subcarrier spacings.

Claim 9. The method of claim 1, wherein selecting the set of subcarriers provides

for orthogonal frequency division multiple access for the user device and at least one other user device.

Claim 10. The method of claim 1, wherein an m^{th} one of the plurality of complex-valued codes is expressed as a set of N code chips, wherein each code chip is expressed by $e^{i2\pi nm/N}$, where e is Euler's number, i is the square root of -1 , π is Pi, and n is an integer.

Claim 11. The method of claim 1, wherein producing the set of subcarrier values employs a fast transform.

Claim 13. [13Pre] An apparatus for communication in a wireless network, comprising:

[13A] at least one processor; and

[13B] at least one non-transitory computer-readable memory in electronic communication with the at least one processor, wherein instructions stored in the at least one non-transitory computer-readable memory are executable by the at least one processor for:

[13Ci] producing a set of subcarrier values that equals a product of a complex-valued code matrix with a matrix of data symbols;

[13Cii] selecting a set of subcarriers assigned for use by a user device; and

[13Ciii] modulating the subcarrier values onto the set of subcarriers to produce a plurality of modulated subcarriers; and

[13Civ] producing a time-domain waveform from a superposition of the plurality of modulated subcarriers, the time-domain waveform to be transmitted in the wireless network by the user device;

[13Cv] wherein producing the set of subcarrier values employs a plurality of complex-valued codes that shapes interference patterns of the superposition to produce a plurality of cyclic-shifted waveforms that each have one of the data symbols modulated thereon.

Claim 18. The apparatus of claim 13, wherein modulating and producing the time-domain waveform is performed using an inverse discrete Fourier transform.

Claim 19. The apparatus of claim 13, wherein selecting the set of subcarriers comprises selecting one of a plurality of selectable subcarrier spacings.

Claim 21. The apparatus of claim 13, wherein selecting the set of subcarriers provides for orthogonal frequency division multiple access for the user device and at least one other user device.

Claim 22. The apparatus of claim 13, wherein an m^{th} one of the plurality of complex-valued codes is expressed as a set of N code chips, wherein each code chip is expressed by $e^{i2\pi nm/N}$, where e is Euler's number, i is the square root of -1 , π is Pi, and n is an integer.

Claim 23. The apparatus of claim 13, wherein producing the set of subcarrier values employs a fast transform.

Claim 25. [25Pre] A computer program product, comprising at least one non-transitory computer-readable memory having computer-readable program code stored thereon, the computer-readable program code containing instructions executable by one or more processors for:

[25A] producing a set of subcarrier values that equals a product of a complex-valued code matrix with a matrix of data symbols;

[25B] selecting a set of subcarriers assigned for use by a user device; and

[25C] modulating the subcarrier values onto the set of subcarriers to produce a plurality of modulated subcarriers; and

[25D] producing a time-domain waveform from a superposition of the plurality of modulated subcarriers, the time-domain waveform to be transmitted in the wireless network by the user device;

[25E] wherein producing the set of subcarrier values employs a plurality of complex-valued codes that shapes interference patterns of the superposition to produce a plurality of cyclic-shifted waveforms that each have one of the data symbols modulated thereon.

Claim 30. The computer program product of claim 24, wherein modulating and producing the time-domain waveform is performed using an inverse discrete Fourier transform.

Claim 31. The computer program product of claim 25, wherein selecting the set of

subcarriers comprises selecting one of a plurality of selectable subcarrier spacings.

Claim 33. The computer program product of claim 25, wherein selecting the set of subcarriers provides for orthogonal frequency division multiple access for the user device and at least one other user device.

Claim 34. The computer program product of claim 25, wherein an m^{th} one of the plurality of complex-valued codes is expressed as a set of N code chips, wherein each code chip is expressed by $e^{i2\pi nm/N}$, where e is Euler's number, i is the square root of -1 , π is Pi, and n is an integer.

Claim 35. The computer program product of claim 24, wherein producing the set of subcarrier values employs a fast transform.

PETITIONER’S EXHIBIT LIST

Exhibit No.	Description
1001	U.S. Patent No. 11,252,005 (“’005 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	[Reserved]
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	José Francia, <i>Proposal for an OFDM-based 802.16.3 Air Interface Physical Layer</i> , IEEE 802.16.3c-00/44 (Oct. 30, 2000)
1010	John Langley, <i>PHY Layer System Proposal for Sub 11 GHz BWA Having SC-FDE and OFDM Modules</i> , IEEE802.16.3c-01/31r2 (Mar. 12, 2001)

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	Hermann Rohling, et al., <i>Broad-Band OFDM Radio Transmission for Multimedia Applications</i> , Proceedings of the IEEE, Vol. 87, No. 10, Oct. 1999 (“Rohling”)
1014	Stephen B. Weinstein, <i>The History of Orthogonal Frequency-Division Multiplexing</i> , IEEE Communications Magazine, pp.26-35 (Nov. 2009)
1015	Richard van Nee & Ramjee Prasad, <i>OFDM for Wireless Multimedia Communications</i> (Artech House 2000)
1016	Karsten Bruninghaus & Herman Rohling, <i>Multi-carrier spread spectrum and its relationship to single-carrier transmission</i> , Vehicular Technology Conference. IEEE 48 th Vehicular Technology Conference, vol. 3, pp.2329-2332 (May 18-21, 1998) (“Brüninghaus”)
1017	File History of U.S. Patent Application No. 17/105,574 as obtained from Patent Center
1018	RESERVED
1019	File History of U.S. Patent Application No. 14/967,633 as obtained from Patent Center (excerpts)
1020	RESERVED
1021	File History of U.S. Patent Application No. 11/187,107 as obtained from Patent Center (excerpts).
1022	RESERVED
1023	File History of U.S. Patent Application No. 10/145,854 as obtained from Patent Center (excerpts).
1024	RESERVED
1025	RESERVED

Exhibit No.	Description
1026	RESERVED
1027	RESERVED
1028	RESERVED
1029	RESERVED
1030	File History of U.S. Patent Application No. 14/727,769 as obtained from Patent Center (excerpts)
1031	File History of U.S. Patent Application No. 14/276,309 as obtained from Patent Center (excerpts)
1032	File History of U.S. Patent Application No. 12/545,572 as obtained from Patent Center (excerpts)
1033	U.S. Patent Application Publication No. 2015/0256308 to Ma et al. (“Ma”)
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	RESERVED
1041	RESERVED
1042	U.S. Patent No. 6,597,745 to Dowling
1043	RESERVED

Exhibit No.	Description
1044	RESERVED
1045	RESERVED
1046	Docket Control Order, <i>Genghiscomm Holdings, LLC v. Samsung Elecs., Am., Inc.</i> , No. 2:24-cv-0242-RWS-RSP, Dkt. 25 (Sept. 24, 2024)
1047	Complaint, <i>Genghiscomm Holdings, LLC v. Samsung Elecs., Am., Inc.</i> , No. 2:24-cv-0242-RWS-RSP, Dkt. 1 (Apr. 12, 2024)
1048	RESERVED
1049	RESERVED
1050	RESERVED
1051	RESERVED
1052	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	RESERVED
1054	RESERVED
1055	RESERVED
1056	RESERVED
1057	RESERVED
1058	RESERVED
1059	Declaration of Gary Swatzell including Exhibits A-D
1060	Guidance on USPTO’s 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.

Exhibit No.	Description
	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	File History of U.S. Patent Application No. 16/199,221 as obtained from Patent Center (excerpts)
1068	File History of U.S. Patent Application No. 16/027,191 as obtained from Patent Center (excerpts)
1069	File History of U.S. Patent Application No. 15/642,850 as obtained from Patent Center (excerpts)
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1076	RESERVED
1077	RESERVED
1078	RESERVED
1079	RESERVED
1080	U.S. Patent Application No. 16/940,383 Electronic Acknowledgment Receipt and Certificate of Correction

Exhibit No.	Description
1081	File History of U.S. Patent Application No. 16/940,383 as obtained from Patent Center.
1082	U.S. Patent No. 10,644,916
1083	U.S. Patent No. 10,574,497
1084	U.S. Patent No. 10,015,034
1085	U.S. Patent No. 9,800,448
1086	U.S. Patent No. 9,628,231
1087	Exhibit 6 to Plaintiff's P.R. 3-1(c) Infringement Contentions (U.S. Pat. No. 11,252,005)
1088	Results of Docket Navigator Search for '005 Patent

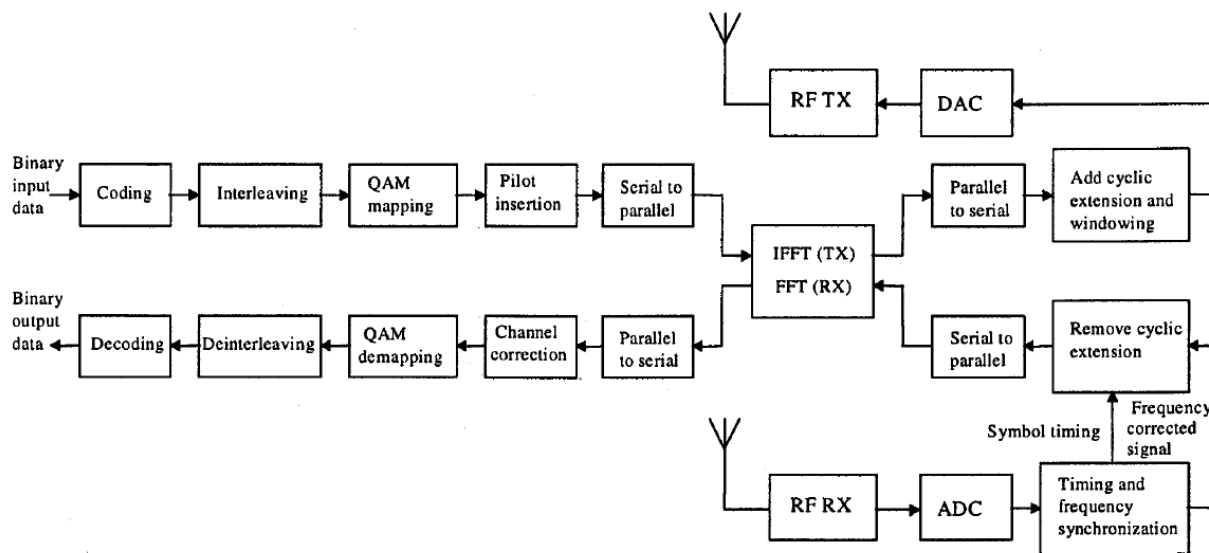
I. GROUNDS FOR STANDING

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. TECHNICAL OVERVIEW

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

A textbook example of an OFDM transceiver is shown below.



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

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

OFDM systems can exhibit high peak-to-average power ratios (“PAPR” or “PAR”). EX1013, p.1780; EX1014, pp.31-32. The Challenged Patent purports to reduce PAPR in OFDM systems by spreading input data using complex-valued codes obtained from a discrete Fourier transform (“DFT”). EX1001, Abstract, 4:3-9.

This technique for reducing PAPR in OFDM was not new. Various publications—including some used in the grounds presented herein—described using DFT spreading codes to reduce PAPR in OFDM systems before the earliest claimed effective filing date. For example, Brüninghaus (1998) observes that when an “FFT matrix” is used “as a spreading matrix for OFDM-CDM” signals, this “leads to a single-carrier system with guard interval.” EX1016, p.2332. Bury (2000) explains that “Fourier spreading” can be “implemented by a discrete Fourier transform (DFT) operation” and the resulting transmission can have a “much lower” PAPR. EX1017, p.857. Galda (2002) “shows how an OFDM-FDMA uplink system can be combined with a user data spreading technique based on the DFT spreading matrix to reduce the PAR of the uplink signal without increasing the computational complexity of the transmitter.” EX1004, p.1738.

Additionally, a POSA knew using variable subcarrier allocations and spacing assignments to provide for more control over uplink communications was being

considered. For instance, various documents submitted to the IEEE for WiMax show variable subcarrier spacings were being considered:

Table 5: Example of numerical values for the OFDM parameters

RF Channel (MHz)	B	7	6	5	3,5	3	1,75
Sampling rate 1/T (MHz)	B	7	6	5	3,5	3	1,75
FFT size N	64	64	64	64	64	64	64
Subcarrier spacing f_c (KHz)	B/64	109,375	93,75	78,125	54,688	46,875	27,344
FFT time T_c (μ s)	64 x T	9,143	10,667	12,800	18,286	21,333	36,571
Cyclic prefix time T_p (μ s)	16 x T	2,286	2,667	3,200	4,571	5,333	9,143
Symbol duration T_s (μ s)	80 x T	11,429	13,333	16,000	22,857	26,667	45,714
Symbol rate f_s (Ksym/s)	1 / T_s	87,500	75,000	62,500	43,750	37,500	21,875
Number of data subcarriers	48	48	48	48	48	48	48
Number of pilot subcarriers	4	4	4	4	4	4	4
Total number of subcarriers	52	52	52	52	52	52	52
Occupied BW (KHz)	53 x f_c	5797	4969	4141	2898	2484	1449

EX1009, p.11.

The tables below show another WiMax proposal in which the base station chooses a FFT size depending on the nature of the traffic (Table 3.5), and the DFT size results in changes to the “OFDM subcarrier spacing” calculated as the sampling rate divided by the FFT size (Table 3.6), thus providing the subcarrier spacings shown in Table 3.7.

Selection Level	Parameter	Symbol	Set of Values
System-Dependent Parameters	Channel Width (MHz)	W	1.75, 3.5, 7, 14, 1.5, 3, 6, 12
	Design Maximum Delay Spread (μsec)	d	4, 10, 20
	Spectral Guard Factor	γ	0.18, 0.25
	Sample Rate (MSam/sec)	R	See Tables 2.1, 2.2
	Number of Pilot Tones	L	[Note 1]
	Number of Guard Tones	G	[Depends on adjacent channel constraints (Note 2)]
Link-Dependent Parameters	Number of QAM States	M	4, 16, 64
	Code Rate	r	1/2, 2/3, 3/4, 7/8
Traffic-Dependent Parameter	FFT Size	N	256, 512, 1024, 2048

Table 3.5 Parameters and Values Defining Operating Modes for MC Systems

Dependent Parameter	Symbol	Formula	Note
Number of Samples in Cyclic Prefix+Postfix	C	$2 \bullet R \bullet d$	2.
Number of Payload Subcarriers	P	$N - G - L$	
Frequency Spacing of Available Channel Estimates Measurable In One Block	e	W / L	
OFDM Symbol Period	S	$(N + C - w) / R$	
OFDM Subcarrier Spacing	s	R / N	3.

Table 3.6 Guidelines for Subsidiary Parameters In MC Systems

FFT Size N	Sample Rate R (MSam/sec)	Subcarrier Spacing (Hz)
256	1.25	4882.813
	1.5	5859.375
	2.5	9765.625
	3	11718.750
	5	19531.250
	6	23437.500
	10	39062.500
512	12	46875.000
	1.25	2441.406
	1.5	2929.688
	2.5	4882.813
	3	5859.375
	5	9765.625
	6	11718.750
1024	10	19531.250
	12	23437.500
	1.25	1220.703
	1.5	1464.844
	2.5	2441.406
	3	2929.688
	5	4882.813
2048	6	5859.375
	10	9765.625
	12	11718.750
	1.25	610.352
	1.5	732.422
	2.5	1220.703
	3	1464.844
	5	2441.406
	6	2929.688
	10	4882.813
	12	5859.375

Table 3.7 Subcarrier Spacing in MC Mode

EX1010, pp.17-19 (describing “Traffic-Dependent Parameters”). Adjusting transmission parameters “greatly increases the efficiency of spectrum utilization.” *Id.*, p.17.

Selecting subcarrier spacing was also being proposed for the nascent LTE standard by 2002. For example, Doufexi describes “key link parameters of OFDM for a potential 4G cellular standard” including “subchannel spacing.” EX1003, p.1. But, because 4G systems “will be deployed in a wide range of environments, a fixed set of parameters is not capable of achieving high performance in all cases.” *Id.*

Therefore, Doufexi proposes “dynamically adapting one or more of the” parameters and provides an example of a system with selectable subcarrier spacings:

Table 2. OFDM Parameters for 4G.

Parameter	Value 1	Value 2
Operating Frequency	2GHz	2GHz
Bandwidth (B)	4096 kHz	4096 kHz
Useful Symbol Duration (T)	62.5 μ s	125 μ s
Guard Interval Duration (T_g)	15.625 μ s ($T/4$)	31.25 μ s ($T/4$)
Total Symbol Duration (T_{symbol})	78.125 μ s (with $GI = T/4$)	156.25 μ s (with $GI = T/4$)
Inner Channel Coding	Punctured 1/2 rate convolution code, Constraint length 7, {133, 171} _{octal}	Punctured 1/2 rate convolution code, Constraint length 7, {133, 171} _{octal}
FFT Size	256	512
Number of data sub-carriers (N_D)	216	432
Sub-carrier spacing (Δf)	16 kHz	8 kHz

EX1003, pp.1-2. An LTE standards submission from Lucent similarly proposed the following parameters for a baseline OFDM system for consideration by 3GPP:

System Parameters	Configuration 1	Configuration 2	Configuration 3
Suitable deployment environment	Indoor, Pedestrian A	Vehicular A	Pedestrian B
Symbol per 0.67 msec time slot	12	6	3
Number of FFT points	256	512	1024
Number of sub-carriers	256	512	1024
OFDM Symbol period (usec)	55.6	111	222
Sub-carrier spacing (kHz)	19.2	9.6	4.8
Guard band on each side of the 5MHz band (kHz)	42.4	42.4	42.4
Sampling period (usec)	0.20345025	0.20345025	0.20345025
Guard time $T_g = T_{prefix} + T_{postfix}$ (samples/usec)	17/3.46	34/6.92	68/13.8
Cyclic prefix length (samples/usec)	5/1.017252604	16/3.255204	50/10.17252604
Power amplifier ramp-up and ramp-down period (samples)	6 samples each	9 samples each	9 samples each

Table 4. Parameters for baseline OFDM systems

EX1006, p.5. Thus, tailoring the number of subcarriers and their spacing to suit different environments and traffic loads was known to a POSITA. EX1002, ¶¶55-62.

III. THE '005 PATENT

A. Overview of the Patent and Challenged Claims

The '005 Patent claims a method, apparatus, and computer program product for (1) producing “subcarrier values” that equals the product of a “complex-valued code matrix” with a “matrix of data symbols,” (2) selecting subcarriers assigned to a device, (3) modulating the subcarrier values onto those subcarriers, and (4) producing a time-domain waveform for transmission over a wireless network by a user device. EX1001, cls. 1, 13, 25.

FIG. 4B is a “block diagram of a spread-OFDM transmitter in accordance with an aspect of the disclosure.” *Id.*, 18:61-62.

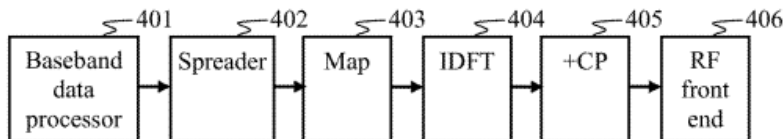


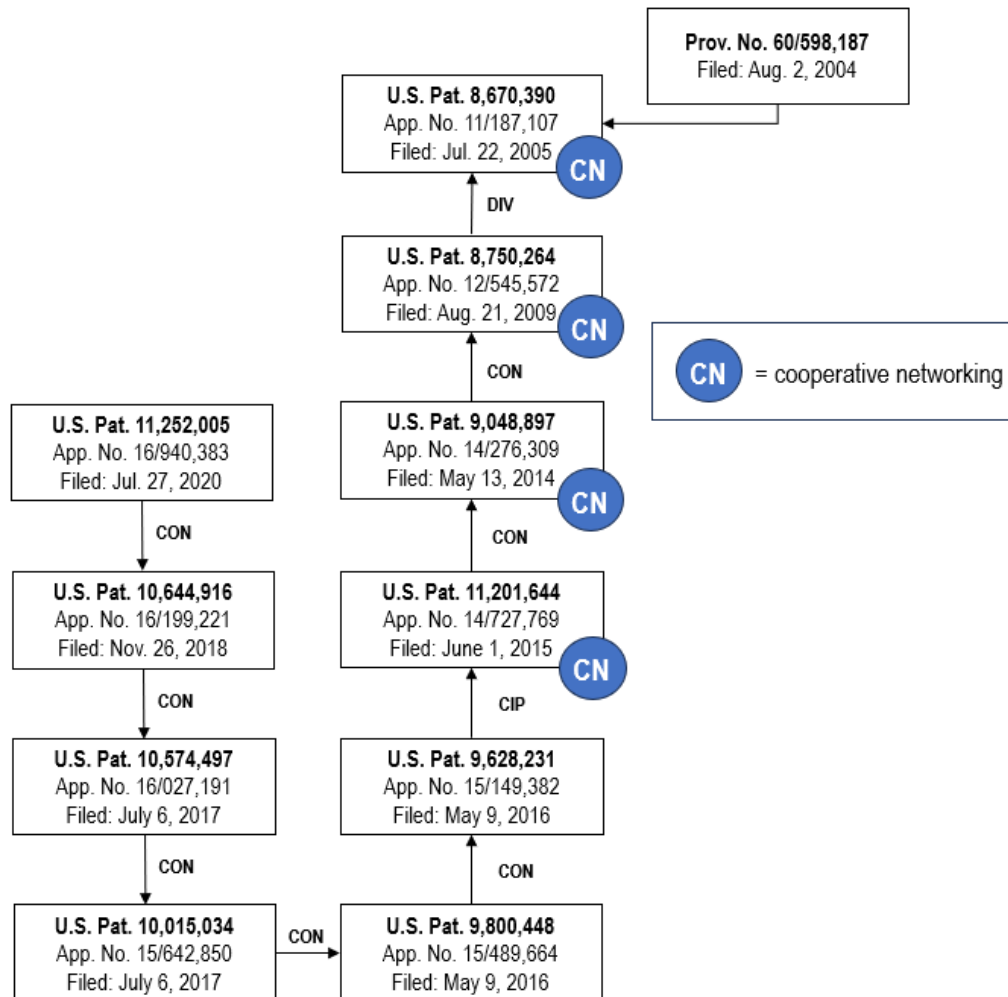
Figure 4A

Data symbols are received from baseband data processor and input to spreader 402. A mapper maps the spread data symbols to OFDM subcarriers, which then are input into an inverse discrete Fourier transform (IDFT) to create an OFDM time-domain signal. *Id.*, 18:62-19:3. A cyclic prefix is added and then the signal is upconverted for transmission over the air. *Id.*, 19:3-8. The spreading codes used by the spreader can be “DFT coefficients” or “DFT-based complex spreading codes.”

Id., 21:9-12, 21:30-32. A benefit of using DFT spreading is the reduction of peak-to-average power ratio of the resulting time-domain OFDM signal. EX1001, 4:5-9, 21:50-53.

B. Prosecution History

The '005 Patent claims the benefit of ten non-provisional applications and one provisional application. The priority claim that appears on the '005 Patent is reflected in the diagram below.



The applications labeled “CN” for cooperative networking address different technologies than those claimed by the ’005 Patent. The prosecution histories are largely given cursory treatment below because claims of those applications are materially different from the claims of the ’005 Patent.

1. Application No. 16/940,383 (Challenged Patent)

The ’005 Patent was allowed without rejection. EX1081, pp.6-7. The Examiner essentially quoted the claim language as being the reason that the claims were allowed. *Id.*, p.7. None of the references relied upon for the Grounds presented in this Petition were applied against the claims of the ’005 Patent.

2. Application No. 16/199,221

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

3. Application No. 16/027,191

The ’191 Application includes claims that also bear some similarity to those of the ’786 Patent. The claims were rejected for obviousness-type double patenting over claims of U.S. Patent No. 10,211,892. EX1068, pp.49-52. A terminal disclaimer

was filed, and the claims were allowed without any indication by the Office about why they were deemed patentable over the prior art. *Id.*, p.19.

4. *Application No. 15/642,850*

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

5. *Application No. 15/489,664*

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

the family or the '644 Application itself:

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

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

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

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

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

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

patent. EX1021, EX1030, EX1031, EX1032.

IV. EFFECTIVE FILING DATE; POST-AIA

The '005 Patent is only entitled to an effective filing date of July 27, 2020 because it lacked co-pendency with the '221 Application through which it claimed priority. Alternatively, the '005 Patent is only entitled to an effective filing date of May 9, 2016 when the specification was materially changed in an attempt to describe what is now claimed in the '005 Patent. For these and other reasons explained in detail below, the '005 Patent is also a post-AIA patent.

A. The '005 Patent Lost Copendency With the Earlier Filed Applications

The application for the '005 Patent was filed on July 27, 2020. EX1001, cover. Its immediate parent application—the '221 Application—issued as U.S. Patent No. 10,644,916 on May 5, 2020—two months before the '005 Patent was filed. EX1082, cover. Additionally, each of the '191, '850, '644, and '382 Applications had also already issued by July 27, 2020. EX1083 (issued Feb. 25, 2020); EX1084 (issued Jul. 3, 2018); EX1085 (issued Oct. 24, 2017); EX1086 (issued Apr. 18, 2017). Therefore, the '005 Patent is not entitled to the benefit of the filing date of any of these earlier-filed applications because they were not copending with the application for the '005 Patent.

B. Application Nos. 14/727,769, 14/276,309, 12/545,572, and 11/187,107 Do Not Describe The Claims Of The '005 Patent

Although the '005 Patent claims the benefit of an August 2, 2004 priority date through the '769, '309, '572, and '107 Applications, those applications fail to describe the claimed subject matter. “It is elementary patent law that a patent application is entitled to the benefit of the filing date of an earlier filed application only if the disclosure of the earlier application provides support for the claims of the later application, as required by 35 U.S.C. § 112.” *PowerOasis, Inc. v. T-Mobile USA, Inc.*, 522 F.3d 1299, 1306 (Fed. Cir. 2008). Because the '769, '309, '572, and '107 Applications fail to disclose the subject matter of the '005 Patent claims, the claims are not entitled to the filing date of any of these applications.

The claims of the '005 Patent require “selecting a set of subcarriers assigned for use by a user device.” EX1001, cls. 1, 13, 25. Dependent claims 7, 19, and 31 require “wherein selecting the set of subcarriers comprises selecting one of a plurality of selectable subcarrier spacings.” EX1001, cls. 7, 19, 31. Using the '769 Application as exemplary,¹ these features are not described in the '769 Application.

¹ For the purposes of this analysis, the '309, '572, and '107 Applications have no relevant distinctions in their disclosures. The disclosures from the '187 Provisional through the '769 Application were expanded over time to describe additional aspects

While the '769 Application describes dividing a “WWAN transmission ... into spectral components (such as denoted by f_1 , f_2 , and f_3 by the WLAN group,” and the WTs “maybe adapted to transmit one or more associated predetermined spectral components to the WWAN node,” these spectral components are not described as being subcarriers that are “selected” or “assigned for use by a user device.” EX1030, p.247; EX1002, ¶¶65-66. Subcarrier spacings are not even mentioned. Nor is technique for selecting subcarrier spacings when selecting subcarriers.

Moreover, the '769 Application describes a different invention than the one being claimed now. That application was titled “Cooperative Wireless Networks.” EX1030, p.233. Its field is “providing cooperative signal processing between a plurality of wireless terminal devices.” EX1030, p.234. The Abstract describes “a cooperative multi-user multiple input, multiple output (MIMO) antenna array,” EX1030, p.311, and all its claims require “a plurality of geographically distributed wireless terminals,” *id.*, pp.304, 305, 308. The '769 Application purports to address a problem that “power, cost, and size constraints typically make the implementation of antenna arrays on mobile wireless terminals ... impractical.” *Id.*, pp.235. The invention coordinated among multiple wireless terminals to make them operate as if

of the cooperative networking techniques, but not in respects relevant to Petitioner’s arguments.

they were a single antenna array. *Id.*, p.236. Indeed, the embodiments are consistent in that they utilize multiple WTs operating together to transmit or receive signals. EX1002, ¶¶67-68. The claims of the '005 Patent, however, are directed to methods, apparatus, and computer-readable media for transmitters that do not depend in any way on other transmitters. EX1002, ¶69. Therefore, they are directed to different subject matter than the '769 Application.

Insofar as Patent Owner attempts to rely on the patent application publications incorporated by reference into the disclosure, *see* EX1030, p.276, 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 '769 Application into the invention disclosed in those other applications. This is improper. *See, e.g., 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.").

Therefore, the effective filing date of the '005 Patent is no earlier than July 27, 2020. Even if the priority claim is corrected (Patent Owner has sought a certificate of correction but has failed to file a petition to accept an unintentionally

delayed priority claim,² EX1080), the subject matter of the claims is, at best, described for the first time in the '382 Application filed on May 9, 2016.

C. The '005 Patent Is a Post-AIA Patent

The '005 Patent is a post-AIA patent for several reasons. First, for the reasons explained above, its effective filing date is no earlier than July 27, 2020 or, in the alternative, May 9, 2016, 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* §§VI.A-B. 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 '005 Patent is a post-AIA patent. Finally, the '005 Patent is a post-AIA patent because one of its parents (the '769 Application) was examined under

² Such a petition was due within 4 months of the original filing date. *See* 37 C.F.R. § 1.78(d)(3)(ii). The request for certificate of correction (EX1080) was filed in December 2024 and the undersigned obtained it from Patent Center. It is no longer on Patent Center without indication of why it appears to have been expunged.

post-AIA law throughout its prosecution over Applicant's objection. EX1030, pp.17, 30, 45, 50-53, 83, 90. 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.

V. IDENTIFICATION OF THE CHALLENGE

Petitioner challenges the following claims on the following grounds:

Ground	Claims	Challenge	Statute
1	1, 6, 9, 10	Anticipation by Galda	Post-AIA §102(a)(1) or Pre-AIA §102(b)
2		Obviousness over Galda	Post- or Pre-AIA §103
3	13, 18, 21, 22, 25, 30, 33, 34	Obviousness over Galda in view of Dowling	Post- or Pre-AIA §103
4	7	Obviousness over Galda in view of Doufexi	Post- or Pre-AIA §103
5	19, 31	Obviousness over Galda and Dowling in view of Doufexi	Post- or Pre-AIA §103
6	7	Obviousness over Galda in view of Lucent	Post- or Pre-AIA §103
7	19, 31	Obviousness over Galda and Dowling in view of Lucent	Post- or Pre-AIA §103
8	7	Obviousness over Galda in view of Ma	Post-AIA §103
9	19, 31	Obviousness over Galda and	Post-AIA §103

Ground	Claims	Challenge	Statute
		Dowling in view of Ma	
10	11	Obviousness over Galda in view of Bury	Post- or Pre-AIA §103
11	23, 35	Obviousness over Galda in view of Dowling and Bury	Post- or Pre-AIA §103

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

Based on the '005 Patent, the prior art and other documentation cited herein, and on Dr. Bims’s testimony a POSITA as of the earliest claimed effective filing date of August 2, 2004 would have had “either a Master’s degree in electrical engineering or a related field, or a Bachelor’s degree in electrical engineering or a related field with three years of experience in wireless communication systems, signal processing, and related technologies.” EX1002, ¶¶71-74. A POSITA would have known that DFT spreading would reduce PAPR in OFDM systems and would have been familiar with hardware and software implementations of mobile device transmitters. *Id.*

VII. 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.

VIII. PRIOR ART STATUS; ANALOGOUS ART

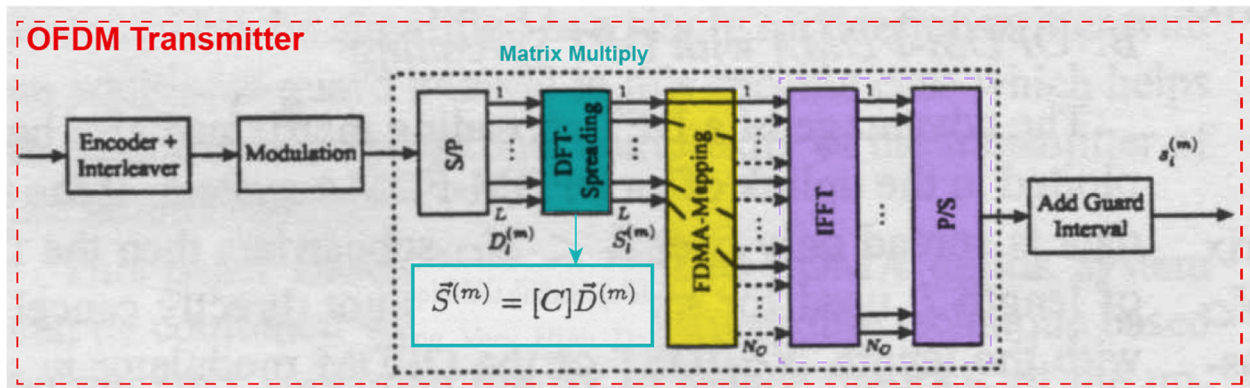
Each reference relied upon in the challenges is analogous prior art. EX1002, ¶¶76-105.

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 and there were no confidentiality restrictions imposed on the conference proceedings, EX1059, ¶¶11-12, and it was expected that the proceedings would be shared widely as confirmed by the fact that the conference proceedings were cataloged into the Linda-Hall Library of Science, Engineering, and Technology less than two months later, then made available on the IEEE website by August 7, 2002. EX1012, ¶52; EX1002, ¶77. Galda is thus a prior art printed publication by at least May 6, 2002 and is prior art under pre-AIA §102(b) or post-AIA §102(a)(1). *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).³

Galda is analogous art to the '005 Patent because it relates to “precoding multicarrier waveforms,” EX1001, 1:26-27, including applying coefficients of a “DFT matrix” to spread data symbols before mapping and OFDM modulating them, EX1001, 4:3-5, 21:44-47; EX1004, pp.1737, 1740 (Fig. 6(a)); EX1002, ¶¶78-79. Galda is also analogous art because one of the problems facing the inventor was reducing PAPR in OFDM communications, EX1001, 4:3-5, 21:44-47, and Galda seeks to solve that problem by spreading symbols using complex-valued codes from

³ Coloring and/or colored text has been added to figures unless otherwise noted.

a DFT—like the '005 Patent, EX1004, p.1737; EX1002, ¶80.

B. Doufexi

Doufexi is a paper from *The 13th IEEE International Symposium on Personal, Indoor and Mobile Radio Communications*. EX1003. Exhibit 1003 was obtained from the Linda Hall Library by Dr. Hall-Ellis. EX1012, ¶65. Doufexi was cataloged into that library on December 30, 2002. EX1012, ¶¶68-69. Additionally, Doufexi was added to the IEEE online database by December 10, 2002. *Id.*, ¶66. Doufexi would have been reasonably accessible to a POSITA because it was cataloged by subject matter including “Wireless communication systems; Mobile Communications systems” as reflected by the Library of Congress classification system, among other indices. *Id.*, ¶70; EX1002, ¶¶81-82. Doufexi is thus a prior art printed publication under pre-AIA §102(b) or post-AIA §102(a)(1).

Doufexi explains that “OFDM is proposed as a leading candidate for a 4G cellular communications standard.” EX1003, p.192. Doufexi “identifies and describes the key link parameters of OFDM for a potential 4G cellular standard” including “subchannel spacing.” *Id.* Doufexi explains that “a fixed set of parameters” would not “achieve high performance in all cases,” and proposes different parameters for different scenarios. *Id.*, pp.192-93.

Doufexi is analogous to the '005 Patent because it is in the field of wireless communications networks, and especially OFDM wireless communications

networks and techniques. EX1001, 1:25-27, 18:61-62; EX1006, p.192 (describing OFDM for 4G networks); EX1002, ¶¶83-84. Doufexi is also reasonably pertinent to a problem faced by the inventor of the '005 Patent, including improvement of OFDM system/spectral efficiency. EX1001, 1:47-67; EX1003, pp.192 (variable guard time can improve efficiency), 193 (“[c]hannel coding also affects bandwidth efficiency”); EX1002, ¶85.

C. Lucent

Lucent is a technical contribution submitted to the 3GPP TSG RAN Working Group 1 (WG1) meeting TSGR1 #28bis, which was held on October 8th and 9th, 2002. EX1034, ¶53; EX1006, p.1. Lucent was publicly available on the 3GPP “public file server from where an interested member of the public exercising reasonable diligence could freely access them.” EX1034, ¶¶41, 54. Lucent was uploaded to the 3GPP public file server on October 8, 2002, *id.*, ¶56, and it was distributed to the members of the RAN WG1 email list on October 8, 2002. *Id.*, p.223. A POSITA would have been able to locate Lucent with a reasonably diligent search based on its categorization on the 3GPP website—run by a prominent organization in the wireless communications industry, *id.*, ¶23—by working group and meeting. EX1034, ¶42; EX1002, ¶¶86-88. Lucent is therefore a prior art printed publication under pre-AIA §102(b) or post-AIA §102(a)(1).

Lucent describes different configurations for a proposed OFDM baseline

system in which the different configurations are associated with different “suitable deployment environment[s].” *Id.*; *see also id.*, p.7 (“We have suggested an OFDM system with multiple configurations that can be deployed in different environments.”). One difference between the three configurations proposed by Lucent is the subcarrier spacing. There are three options: 19.2 kHz, 9.6 kHz, and 4.8 kHz as shown in the table below.

System Parameters	Configuration 1	Configuration 2	Configuration 3
Suitable deployment environment	Indoor, Pedestrian A	Vehicular A	Pedestrian B
Symbol per 0.67 msec time slot	12	6	3
Number of FFT points	256	512	1024
Number of sub-carriers	256	512	1024
OFDM Symbol period (usec)	55.6	111	222
Sub-carrier spacing (kHz)	19.2	9.6	4.8
Guard band on each side of the 5MHz band (kHz)	42.4	42.4	42.4
Sampling period (usec)	0.20345025	0.20345025	0.20345025
Guard time $T_g = T_{prefix} + T_{postfix}$ (samples/usec)	17/3.46	34/6.92	68/13.8
Cyclic prefix length (samples/usec)	5/1.017252604	16/3.255204	50/10.17252604
Power amplifier ramp-up and ramp-down period (samples)	6 samples each	9 samples each	9 samples each

Id.

Lucent is analogous to the '005 Patent because it is in field of wireless communications networks, and especially OFDM wireless communications networks and techniques. EX1001, 1:25-27, 18:61-62; EX1006, p.1 (“Proposed

Baseline OFDM Systems for Study”); EX1002, ¶¶89-92. And Lucent is reasonably pertinent to a problem to be solved by the ’005 Patent inventor, namely the efficient FFT operations. EX1001, 22:28-30 (implementing “DFT spreading as a fast algorithm (FFT) can provide an efficient alternative to conventional Carrier Interferometry (CI) coding”); EX1006, p.3 (“the most efficient choices of the FFT operations are...”); EX1002, ¶93.

D. Ma

Ma is a U.S. Patent Application Publication filed on February 20, 2015 and published on September 10, 2015. EX1033, cover. Ma claims the benefit of Provisional Application No. 61/949,805 filed March 7, 2014. *Id.* If Petitioner prevails on its arguments regarding the effective filing date of the ’005 Patent Ma is prior art under post-AIA §102(a)(1). *Supra* §IV.

Ma describes systems and methods for implementing variable subcarrier spacings and symbol durations in OFDM systems. EX1033, ¶[0002]. Ma partitions frequency and time planes into “multiple access block” (“MAB”) regions where each MAB has a different subcarrier spacing and symbol duration. *Id.*, ¶¶[0004], [0028], [0030]-[0031], Fig. 5. This increases system flexibility. *Id.*, ¶[0003].

Ma is analogous to the ’005 Patent because both relate to wireless communications networks, and especially OFDM wireless communications networks and techniques. EX1001, 1:25-27, 18:61-62; EX1033, ¶¶[0002], [0033];

EX1002, ¶¶99-100. And Ma is reasonably pertinent to a problem to be solved by the '005 Patent inventor, namely the improvement of OFDM system/spectral efficiency.

EX1001, 1:47-67; EX1033, ¶¶[0003], [0023], [0036]; EX1002, ¶101.

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, 3:46-50, 5:66-6:1.

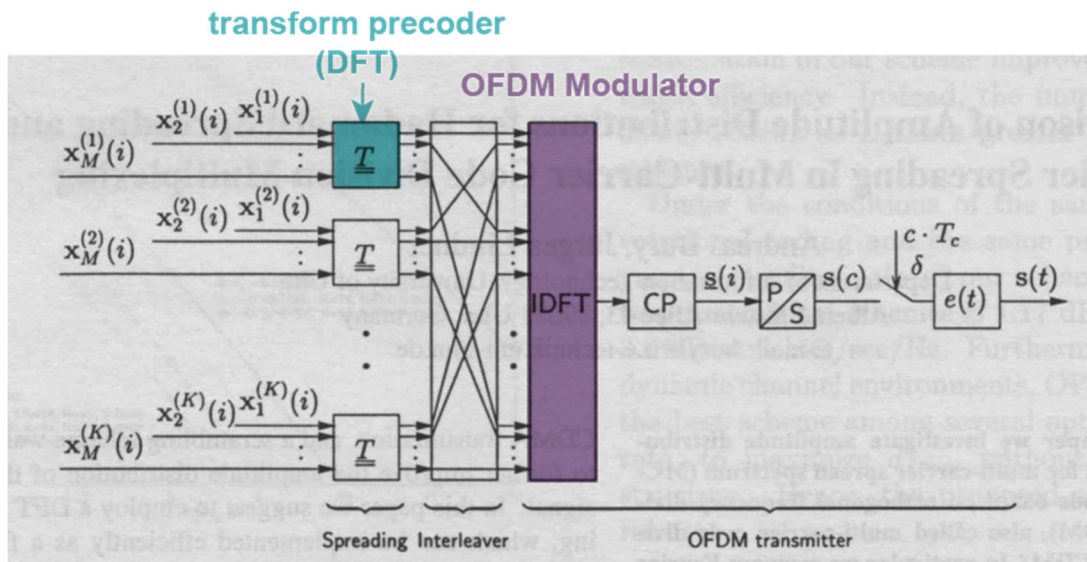
Dowling is analogous to the '005 Patent at least because it is in the same field of endeavor—namely wireless communications including OFDM communications. EX1001, 1:25-27, 18:61-62, EX1042, 1:6-12 (“field” relates to “data transmission,” more specifically to a “precoder” for multicarrier (e.g., OFDM) systems), 21:62-64 (invention “applied to other FFT based multicarrier modulation and OFDM systems.”); EX1002, ¶¶102-04. Both the '005 Patent and Dowling are also applicable to DMT (discrete multitone) communications. EX1001, 5:23-28; EX1042, Abstract.

F. 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, ¶94. 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 to spread data symbols in OFDM wireless communications systems. EX1001, Abstract, 1:25-27, 21:9-12, 21:30-33; EX1007, pp.857-860; EX1002, ¶¶95-97. Bury is also analogous because a problem facing the inventor was reducing PAPR in OFDM

communications, EX1001, 4:24-42, and Bury solves that problem by spreading symbols using complex-valued codes from a DFT, EX1007, pp.857, 860; EX1002, ¶97.

IX. DETAILED DISCUSSION

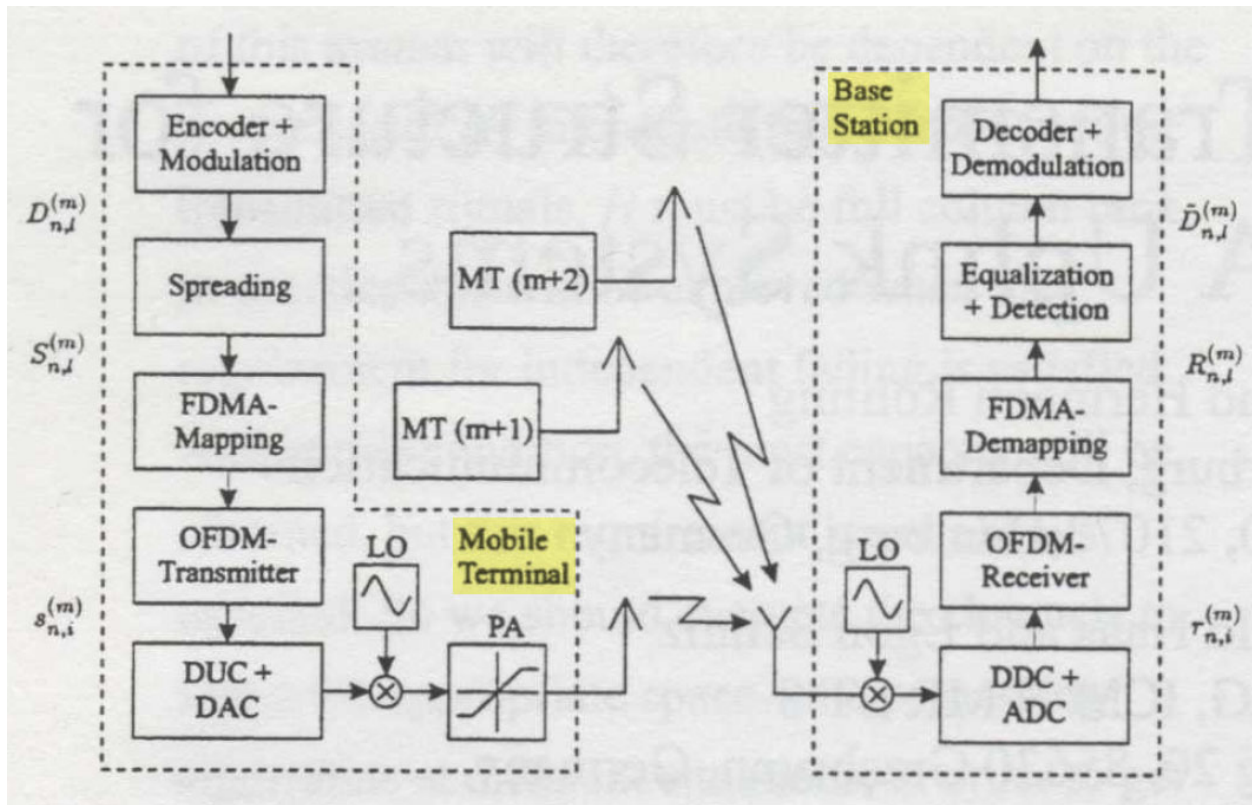
A. Grounds 1 and 2: Claims 1, 6, 9, and 10 are (Ground 1) anticipated by or (Ground 2) obvious over Galda

1. Claim 1

a. [1Pre]: Method for wireless communication

Assuming that the preamble is limiting Galda discloses and renders obvious “[a] method for communication in a wireless network.” EX1002, ¶¶105-19.

Galda describes an OFDM “transmission technique.” EX1004, p.1737. Galda’s OFDM transmission technique includes spreading data symbols with “a Discrete Fourier Transform (DFT) spreading matrix” before mapping and OFDM modulation, and ultimately *communication in a wireless transmission network* as shown below where “Mobile Terminal” transmits wirelessly to “Base Station”:



EX1004, p.1738 (Fig. 1).

Thus, Galda discloses and renders obvious (as explained below) **[1Pre]**.

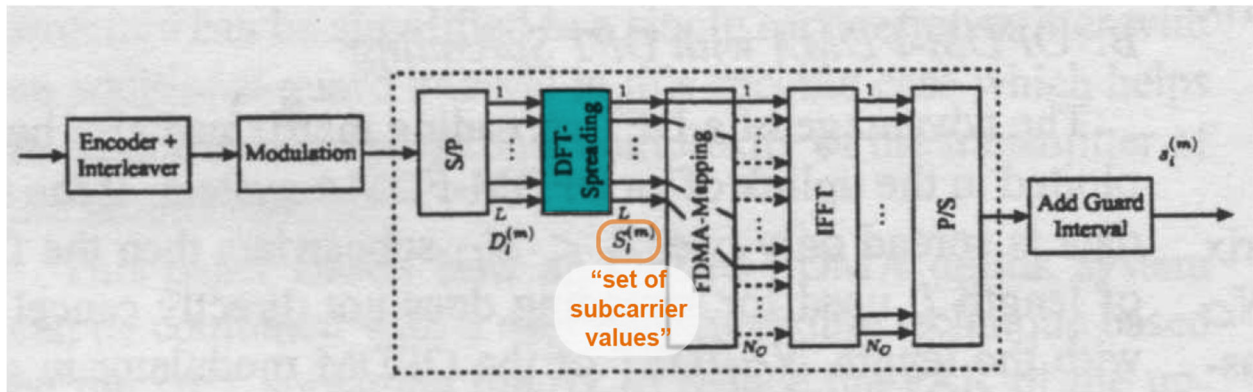
b. **[1A]: producing subcarrier values**

Galda also discloses and renders obvious *producing a set of subcarrier values that equals a product of a complex-valued code matrix with a matrix of data symbols.*

EX1002, ¶¶120-28.

Galda produces *a set of subcarrier values* which are indicated by $S_l^{(m)}$ —i.e., “ L complex transmit symbols $S_l^{(m)}$ ”—(or, in vector notation, “ $\vec{S}^{(m)}$ ”). EX1004, p.1738. The *set of subcarrier values* are called “ L complex transmit symbols” in Galda. *Id.* The set of subcarrier values are shown below as being output from the

“DFT spreading” block:



EX1004, p.1740 (Fig. 6(a)); EX1002, ¶121.

Galda’s *set of subcarrier values* (“ L complex transmit symbols $S_l^{(m)}$,” (also expressed as $\vec{S}^{(m)}$)) equal a *product of a complex-valued code matrix* (“unitary spreading matrix $[C]$ ”) with a *matrix of data symbols* (“complex modulation symbols” $D_l^{(m)}$, which are also represented as column vector (matrix) $\vec{D}^{(m)}$).

EX1004, p.1738; EX1002, ¶122. Galda explains that

The L modulation symbols are spread over the L user specifically allocated subcarrier with an unitary spreading matrix $[C]$ resulting in L complex transmit symbols The spreading operation can be denoted mathematically by the following simple matrix multiplication

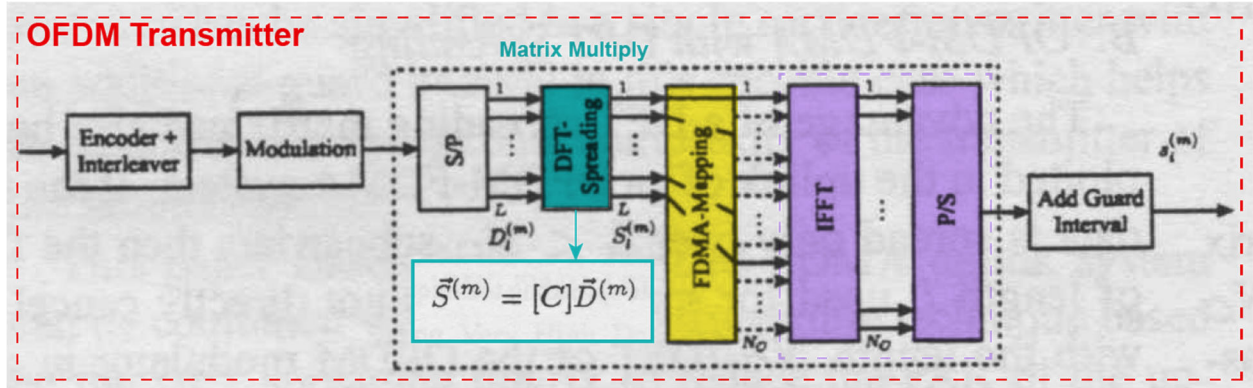
$$\vec{S}^{(m)} = [C]\vec{D}^{(m)} \quad (1)$$

where each complex transmit symbol $S_l^{(m)}$ is calculated by the sum of L user modulation symbols $D_l^{(m)}$ weighted by L orthogonal code vectors $\vec{C}_l = (C_{l,0}, C_{l,1}, \dots, C_{l,l})$ with

$$l = 0, \dots, L - 1$$

$$S_l^{(m)} = \sum_{v=0}^{L-1} C_{l,v} D_v^{(m)} \quad \text{for } l = 0, \dots, L - 1. \quad (2)$$

EX1004, p.1738. This is shown in annotated Fig. 6(a) below:



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

Galda's matrix $[C]$ is a *complex-valued code matrix* because Galda uses the “Discrete Fourier Transformation (DFT) matrix” to perform spreading and “the elements of the discrete Fourier matrix” are given by the following expression:

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

EX1004, p.1739; EX1002, ¶¶123-25. The exponential function reflects complex-valued code elements of Galda's DFT spreading matrix $[C]$ because of the presence of j , which is equal to $\sqrt{-1}$. EX1002, ¶126; cf. EX1001, 54:54-55 (providing alternative notation for complex number, i.e., i is $\sqrt{-1}$).

Galda's column vector $\vec{D}^{(m)}$, which has elements $D_l^{(m)}, l=0, \dots, L-1$ of

“complex modulation symbols,” is a *matrix of data symbols*. EX1004, p.1738; EX1002, ¶127. At the very least, a POSITA would have found it obvious to express $D_l^{(m)}$, $l=0, \dots, L-1$ as a *matrix of data symbols* because, as Patent Owner has admitted in co-pending litigation, a column vector representation of the input signal (i.e., Galda’s $\vec{D}^{(m)}$) is a “matrix of data symbols” as shown below:

By collecting the DFT output samples into a column vector, we have

$$\underbrace{\begin{bmatrix} X(\omega_0) \\ X(\omega_1) \\ X(\omega_2) \\ \vdots \\ X(\omega_{N-1}) \end{bmatrix}}_{\underline{X}} = \underbrace{\begin{bmatrix} \overline{s_0(0)} & \overline{s_0(1)} & \cdots & \overline{s_0(N-1)} \\ \overline{s_1(0)} & \overline{s_1(1)} & \cdots & \overline{s_1(N-1)} \\ \overline{s_2(0)} & \overline{s_2(1)} & \cdots & \overline{s_2(N-1)} \\ \vdots & \vdots & \vdots & \vdots \\ \overline{s_{N-1}(0)} & \overline{s_{N-1}(1)} & \cdots & \overline{s_{N-1}(N-1)} \end{bmatrix}}_{\mathbf{S}_N^*} \underbrace{\begin{bmatrix} x(0) \\ x(1) \\ x(2) \\ \vdots \\ x(N-1) \end{bmatrix}}_{\underline{x}}$$

* * * *

where $\mathbf{S}_N^*$ denotes the DFT matrix $\mathbf{S}_N^*[k, n] \triangleq W_N^{-kn} \triangleq e^{-j2\pi kn/N}$, i.e.,

EX1087, p.5 (red annotations Patent Owner’s); EX1002, ¶128.

Galda thus discloses and renders obvious Limitation [1A].

c. [1B]: selecting subcarriers

Galda discloses and renders obvious *selecting a set of subcarriers assigned for use by a user device*. EX1002, ¶¶130-35.

Galda describes an OFDM modulation process that includes selection of the L subcarriers on which to modulate the “ L complex transmit symbols $S_l^{(m)}$,” (also expressed as $\vec{S}^{(m)}$) to a “selected subcarrier set” that is “exclusively allocated to user

m.” EX1004, pp.1738, 1740 (Fig. 6(a)).

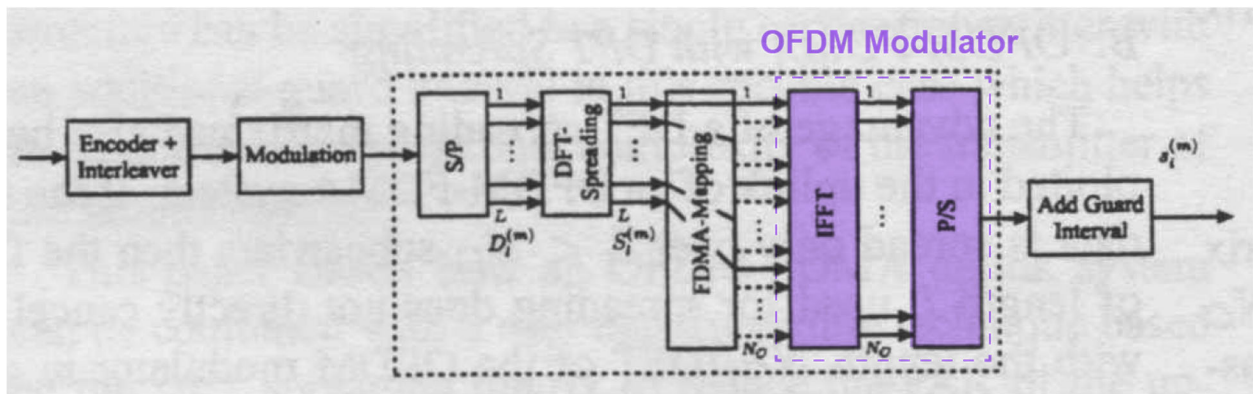
Based on the subcarriers uniquely allocated to user *m*, Galda’s OFDM transmitter performs the function of selecting the *L* subcarriers from among N_C subcarriers that make up the aggregate of “available” subcarriers. EX1004, p.1738 (“The transmit symbols $S_l^{(m)}$ are then mapped onto *L* of the available N_C subcarrier which are exclusively allocated to user *m*.”); EX1002, ¶¶131-32. Galda explains that “the set of subcarrier assigned to each user can be composed of any *L* out of N_C subcarrier that have not been assigned to another user.” EX1004, p.1738. This provides flexibility in the management of radio resources. EX1002, ¶¶133-34. Galda’s *selecting* allows the transmitter to “spread the user data over the allocated subcarrier only.” EX1004, p.1737.

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

d. [1C]: modulating values onto subcarriers

Galda discloses *modulating the subcarrier values onto the set of subcarriers to produce a plurality of modulated subcarriers*. EX1002, ¶¶136-39.

Galda discloses an OFDM modulator (called “OFDM-Transmitter” in Fig. 1) as shown below.



EX1004, p.1740 (Fig. 6(a)). The modulator uses an IFFT and thus modulates Galda’s *subcarrier values* (“ L complex transmit symbols $S_l^{(m)}$ ”) *onto the set of subcarriers* (Galda’s “ L of the available N_C subcarriers”) to produce a *plurality of modulated subcarriers* in the same way that is described in the ’005 Patent. EX1004, pp.1738, 1740; EX1001, 23:58 (referring to “subcarrier modulation (e.g., via IFFT)”), 30:49-51 (“The IFFT modulates the spread data symbols onto the assigned (or selected) OFDM subcarriers to produce a spread-OFDM signal 705.”); EX1002, ¶¶137-38.

Thus, Galda discloses Limitation [1C].

e. [1D]: producing time-domain waveform

Galda discloses and renders obvious *producing a time-domain waveform from a superposition of the plurality of modulated subcarriers* (Galda’s modulated subcarriers are summed to create a time-domain waveform from a superposition of modulated subcarriers, i.e., $s_i^{(m)}$), *the time-domain waveform to be transmitted in the wireless network by the user device* (Galda’s time-domain waveform $s_i^{(m)}$ is

transmitted from “Mobile Terminal” to “Base Station”). EX1002, ¶¶140-47.

Galda describes *producing a time-domain waveform* $s_i^{(m)}$. For example, Galda provides the following expression for the *time-domain waveform*—what Galda calls the “resulting OFDM time signal of user m ”:

$$s_i^{(m)} = e^{j2\pi im/N_c} \frac{1}{\sqrt{L}} \sum_{l=0}^{L-1} S_l^{(m)} e^{-j2\pi il/L} \quad (3)$$
$$\text{for } i = -N_G, \dots, 0, \dots, N_G,$$

where the summation of subcarriers from $l = 0$ to L represents a superposition of the subcarriers modulated by the set of subcarrier values $S_l^{(m)}$ where l ranges from 0 to $L-1$.⁴ EX1004, pp.1738, 1739; EX1002, ¶¶141-44.

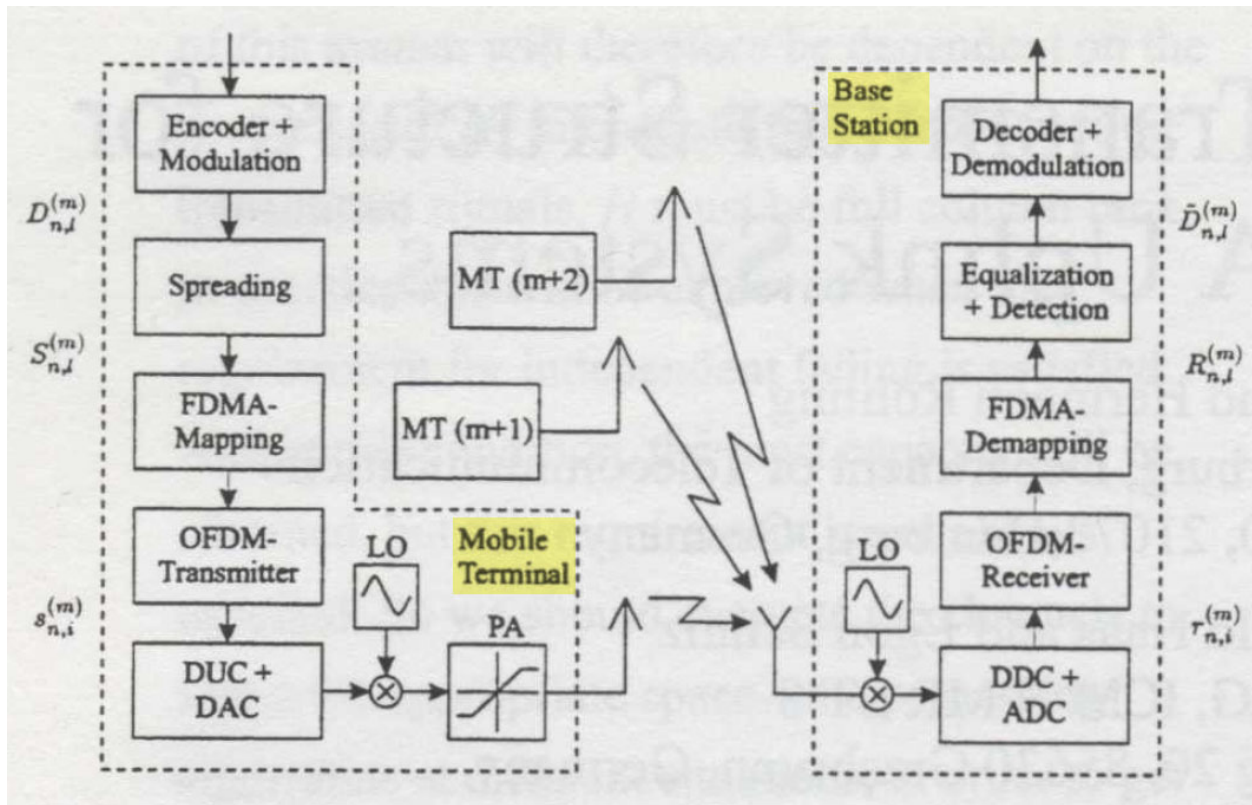
Because Galda uses an IFFT for OFDM modulation the resulting signal is a *superposition of the plurality of modulated subcarriers*. EX1004, p.1737 (“[T]he OFDM transmit signal results from the superposition of a large number of independent data symbols....”). To the extent the Board determines that Galda does not expressly disclose the claimed *superposition of modulated subcarriers*, it would

⁴ Galda provides another expression for the OFDM time-domain waveform that substitutes in the DFT matrix coefficients and the “complex modulation symbols”:

$$s_i^{(m)} = e^{j2\pi im/N_c} \cdot \frac{1}{\sqrt{L}} \cdot \sum_{l=0}^{L-1} \sum_{v=0}^{L-1} C_{l,v} D_v^{(m)} e^{-j2\pi il/L}. \text{ EX1004, p.1739.}$$

have been obvious to a POSITA that Galda's *time-domain waveform* is produced from a *superposition of the plurality of modulated subcarriers* based on Galda's disclosure of an "OFDM time signal" (which is a "superposition"), EX1004, pp.1737, 1738, because Patent Owner has admitted in co-pending litigation that a POSITA "at the time of the invention would understand that an OFDM signal is a superposition of subcarriers" and is "a sum (i.e., a superposition) of the subcarrier frequencies modulated with their corresponding symbols." EX1039, p.10; EX1047, p.8 (Patent Owner admitting that a POSITA "would understand that an OFDM signal is a superposition of subcarriers"); EX1087, p.8 (same); EX1002, ¶¶144-45.

Galda's *time-domain waveform* is to be transmitted in the wireless network by the user device as shown in Galda's Fig. 1, which shows transmissions of the signal after DAC and amplification from "Mobile Terminal" to "Base Station." EX1004, p.1738; EX1002, ¶146.



EX1004, p.1738 (Fig. 1).

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

- f. [1E]: interference patterns of the superposition and a plurality of cyclic-shifted waveforms

Galda also discloses *wherein producing the set of subcarrier values* (“*L* complex transmit symbols $S_l^{(m)}$ ”) *employs a plurality of complex-valued codes* (“*L* orthogonal code vectors $\vec{C}_l$ ”) *that shapes interference patterns of the superposition to produce a plurality of cyclic-shifted waveforms that each have one of the data symbols modulated thereon.* EX1002, ¶¶146-58.

Galda employs a plurality of complex-valued codes because Galda describes

the “unitary spreading matrix” $[C]$ that has “elements of the discrete Fourier matrix” defined as: $C_{i,j} = \frac{1}{\sqrt{L}} e^{j2\pi ij/L}$. EX1004, pp.1738, 1739. The matrix $[C]$ includes “ L orthogonal code vectors $\vec{C}_l = (C_{l,0}, C_{l,1}, \dots, C_{l,L})$ with $l = 0, \dots, L - 1$.” *Id.*, p.1738. Thus, “the elements of the discrete Fourier matrix” can be expressed as: $\vec{C}_l = \frac{1}{\sqrt{L}} (e^{j2\pi l0/L}, e^{j2\pi l1/L}, \dots, e^{j2\pi l(L-1)/L})$. EX1002, ¶¶149-50; EX1004, pp.1738-1739. Thus, Galda uses a plurality of complex-valued codes $\vec{C}_l$. EX1002, ¶150.

The plurality of complex-valued codes $\vec{C}_l$ impart a cyclic shift to the encoded data symbols—i.e., the claimed *subcarrier values*—(“ L complex transmit symbols $S_l^{(m)}$ ”) and thus the resulting waveforms. For example, in a situation in which $L=4$, Galda’s DFT spreading matrix takes on the following values:

$$[C] = \begin{bmatrix} C_{0,0} & C_{0,1} & C_{0,2} & C_{0,3} \\ C_{1,0} & C_{1,1} & C_{1,2} & C_{1,3} \\ C_{2,0} & C_{2,1} & C_{2,2} & C_{2,3} \\ C_{3,0} & C_{3,1} & C_{3,2} & C_{3,3} \end{bmatrix} = \begin{bmatrix} \frac{1}{2} e^{j\frac{2\pi(0)(0)}{4}} & \frac{1}{2} e^{j\frac{2\pi(0)(1)}{4}} & \frac{1}{2} e^{j\frac{2\pi(0)(2)}{4}} & \frac{1}{2} e^{j\frac{2\pi(0)(3)}{4}} \\ \frac{1}{2} e^{j\frac{2\pi(1)(0)}{4}} & \frac{1}{2} e^{j\frac{2\pi(1)(1)}{4}} & \frac{1}{2} e^{j\frac{2\pi(1)(2)}{4}} & \frac{1}{2} e^{j\frac{2\pi(1)(3)}{4}} \\ \frac{1}{2} e^{j\frac{2\pi(2)(0)}{4}} & \frac{1}{2} e^{j\frac{2\pi(2)(1)}{4}} & \frac{1}{2} e^{j\frac{2\pi(2)(2)}{4}} & \frac{1}{2} e^{j\frac{2\pi(2)(3)}{4}} \\ \frac{1}{2} e^{j\frac{2\pi(3)(0)}{4}} & \frac{1}{2} e^{j\frac{2\pi(3)(1)}{4}} & \frac{1}{2} e^{j\frac{2\pi(3)(2)}{4}} & \frac{1}{2} e^{j\frac{2\pi(3)(3)}{4}} \end{bmatrix}$$

EX1002, ¶151. These codes apply a set of carrier phases when producing Galda’s subcarrier values $S_l^{(m)}$ where l ranges from 0 to $L-1$, such that when the subcarrier values are modulated onto the subcarriers the resulting subcarriers also exhibit the phase shift imparted by the code.

When the resulting phase-shifted subcarriers undergo the OFDM modulation process via Galda's IFFT, this results in shaping of the *interference patterns of the superposition* ($s_i^{(m)}$) *to produce a plurality of cyclic-shifted waveforms that each have one of the data symbols modulated thereon.* EX1002, ¶¶151-52. As Galda explains:

The transmit time signal $s_i^{(m)}$ of user m in an OFDM-FDMA uplink using DFT spreading matrix and an equidistant subcarrier allocation results therefore in a periodic repetition of the complex user data symbol $D_i^{(m)}$ sequence including an added guard interval as cyclic prefix, shown in Fig. 5. This periodic data sequence is multiplied by a user specific complex signal $e^{j2\pi im/N_C}$ due to the user individual frequency shift by m subcarriers of the complete allocated subcarrier set. The number of periods inside a single OFDM symbol is equal to the spacing M of the subcarriers allocated to user m .

EX1004, pp.1739-1740. This is demonstrated in Galda's mathematical expressions for the case of equally spaced subcarriers:

$$\begin{aligned}
 s_i^{(m)} &= e^{j2\pi im/N_C} \cdot \frac{1}{\sqrt{L}} \cdot \sum_{l=0}^{L-1} \sum_{v=0}^{L-1} C_{l,v} D_v^{(m)} e^{-j2\pi il/L} \\
 &= e^{j2\pi im/N_C} \cdot \frac{1}{L} \sum_{v=0}^{L-1} D_v^{(m)} \underbrace{\sum_{l=0}^{L-1} e^{j2\pi(v-i)l/L}}_{= L \delta_L(v-i)}
 \end{aligned}$$

$$= e^{j2\pi im/N_C} \cdot \sum_{v=0}^{L-1} D_v^{(m)} \delta_L(v-i)$$

$$s_i^{(m)} = e^{j2\pi im/N_C} \cdot D_{i \bmod L}^{(m)} \quad (7)$$

EX1004, p.1739. Here, the *plurality of complex-valued codes* $\vec{C}_l$ (represented by their elements “ $C_{l,v}$ ” and highlighted blue) shape *interference patterns of the superposition* (highlighted yellow) to produce *a plurality of cyclic-shifted waveforms* (each represented by “the periodic dirac pulse sequence $\delta_L()$ ” and highlighted green) that each have *one of the data symbols* (represented by “ $D_v^{(m)}$,” and highlighted pink) modulated thereon. EX1002, ¶¶153-54. In the second line of expression 7 of Galda,

$$L \delta_L(v-i) = \sum_{l=0}^{L-1} e^{j2\pi(v-i)l/L},$$

where

- $\delta_L(v-i)$ represents L *cyclic-shifted waveforms* produced from the *interference patterns of the superposition* $\sum_{l=0}^{L-1} e^{j2\pi(v-i)l/L}$ and
- $\sum_{l=0}^{L-1} e^{j2\pi(v-i)l/L}$ is a restructuring of $\sum_{l=0}^{L-1} C_{l,v} e^{-j2\pi il/L}$ shown in the first line of expression 7 that represents how the *plurality of complex-valued codes* $\vec{C}_l$ shape the *interference patterns of the superposition* to produce the L *cyclic-shifted waveforms*

$$\sum_{l=0}^{L-1} \underbrace{e^{j2\pi lv/L}}_{C_{l,v} = \vec{C}_l} \cdot e^{-j2\pi il/L} = \sum_{l=0}^{L-1} e^{j2\pi(v-i)l/L} = L \delta_L(v-i).$$

EX1002, ¶154; EX1004, p.1739.

As Dr. Bims explains, $\delta_L(v-i)$ represents L cyclic-shifted waveforms defined as:

$$\delta_L(v-i) = \begin{cases} 1, & \text{for } v \bmod L = i \bmod L \\ 0, & \text{otherwise} \end{cases}$$

where v identifies a particular one of the L cyclic-shifted waveforms having a unique shift v , where $v = 0, \dots, L-1$, i indexes the waveform samples, and L defines each cyclic-shifted waveform's cyclic nature. EX1002, ¶155. For example, $\delta_L(0-i)$ represents a first cyclic-shifted waveform that is equal to 1 whenever $i \bmod L = 0$, and $\delta_L(1-i)$ represents a second cyclic-shifted waveform that is equal to 1 whenever $i \bmod L = 1$. *Id.*

When $N_C = 8$, $M = 4$, and $L = 2$ as in the example illustrated in Fig. 5 of Galda, $\delta_L(v-i)$ becomes $\delta_2(v-i)$ and $s_i^{(m)}$ may be expressed as

$$\begin{aligned} s_i^{(m)} &= e^{j2\pi im/8} \cdot \sum_{v=0}^{2-1} D_v^{(m)} \delta_2(v-i) \\ &= e^{j2\pi im/8} \left(D_0^{(m)} \delta_2(0-i) + D_1^{(m)} \delta_2(1-i) \right) \end{aligned}$$

where $\delta_2(0-i)$ is a first of a plurality of cyclic-shifted waveforms that has a first

one of the data symbols $D_0^{(m)}$ modulated thereon, and $\delta_2(1 - i)$ is a second of the *plurality of cyclic-shifted waveforms* that has a second one of the data symbols $D_1^{(m)}$ modulated thereon. EX1002, ¶¶156-157; EX1004, p.1739. In this example, $\delta_2(0 - i)$ is a cyclic-shifted waveform that is equal to 1 whenever $i \bmod 2 = 0$ (i.e., when $i = -2, 0, 2, 4, \text{ or } 6$), and $\delta_2(1 - i)$ is a cyclic-shifted waveform that is equal to 1 when $i \bmod 2 = 1$ (i.e., when $i = -1, 1, 3, 5, \text{ or } 7$) as shown below:

i		-2	-1	0	1	2	3	4	5	6	7	
$\delta_2(0 - i)$		1	0	1	0	1	0	1	0	1	0	
$\delta_2(1 - i)$		0	1	0	1	0	1	0	1	0	1	

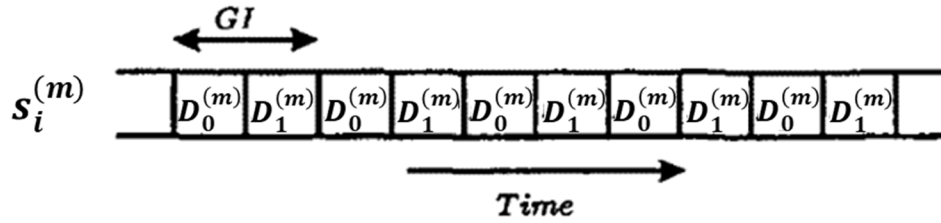
EX1002, ¶¶156-157. Thus, $D_0^{(m)}\delta_2(0 - i)$ and $D_1^{(m)}\delta_2(1 - i)$ may be illustrated as:

$D_0^{(m)}\delta_2(0 - i)$		$D_0^{(m)}$		$D_0^{(m)}$		$D_0^{(m)}$		$D_0^{(m)}$		$D_0^{(m)}$		
$D_1^{(m)}\delta_2(1 - i)$			$D_1^{(m)}$		$D_1^{(m)}$		$D_1^{(m)}$		$D_1^{(m)}$		$D_1^{(m)}$	

and

$$s_i^{(m)} = e^{j2\pi im/8} \left(D_0^{(m)}\delta_2(0 - i) + D_1^{(m)}\delta_2(1 - i) \right)$$

may be illustrated in a simplified form like that shown in Fig. 5 of Galda⁵ as



Id.

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

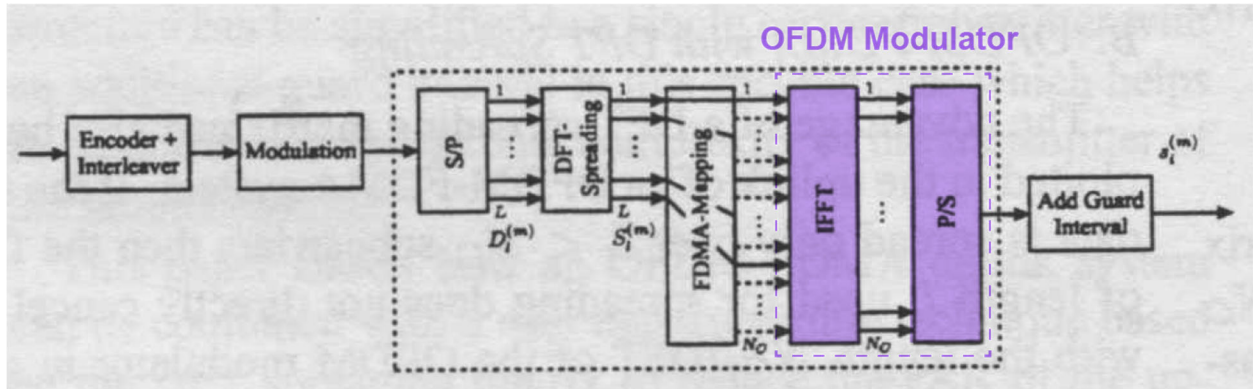
2. Claim 6

Galda discloses and renders obvious *wherein modulating and producing the time-domain waveform is performed using an inverse discrete Fourier transform.*

EX1002, ¶¶159-62.

⁵ A POSITA would understand that Galda's Fig. 5 simplifies expression 7 and omits the term " $e^{j2\pi im/8}$ " to illustrate the periodic repetition of the complex user data symbol $D_l^{(m)}$ sequence. EX1002, ¶157. A POSITA would also have understood that the indices of the complex user data symbol $D_l^{(m)}$ sequence used in Galda's Fig. 5 is one-based indexing (i.e., ranges from 1 to L), rather than the zero-based indexing (i.e., ranges from 0 to $L-1$) as used in expression 7 and Petitioner's example. *Id.* This change in nomenclature has no bearing on the resulting mathematics nor how Galda meets the claims. *Id.*

Galda shows an inverse fast Fourier transform (IFFT) that is used to modulate the subcarrier values to *modulate and produce time-domain waveform* ($s_i^{(m)}$):



EX1004, p.1740 (Fig. 6(a)). An IFFT is a type of *inverse discrete Fourier transform* (IDFT) as conceded by the '005 Patent. EX1001, 34:42-43 (“[A]n IDFT can be implemented as an IFFT....”); EX1002, ¶¶160-61.

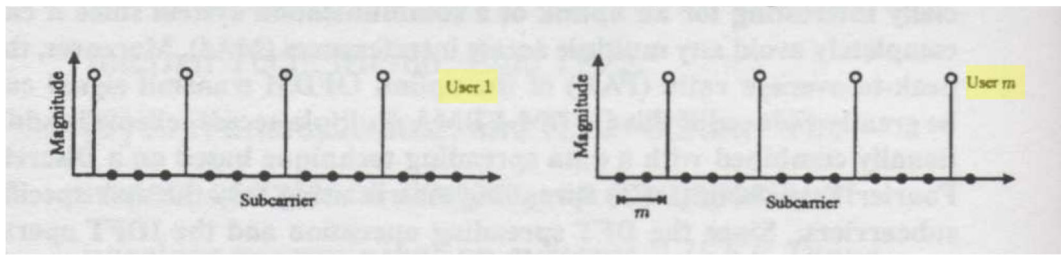
Thus, Galda discloses and renders obvious claim 6.

3. Claim 9

Galda discloses and renders obvious wherein *selecting the set of subcarriers provides for orthogonal frequency division multiple access for the user device and at least one other user device*. EX1002, ¶¶163-66.

Galda explains that the system can include a total of N_C subcarriers, of which L subcarriers are allocated to a particular user. EX1004, p.1038 (“In principle, the set of subcarrier assigned to each user can be composed of any L out of N_C subcarrier that have not been assigned to another user.”). Galda gives an example of *selecting the set of subcarriers for the user device* (e.g., of “User 1”) and *at least one other*

user device (“User m”) as shown below:



EX1004, p.1738; EX1002, ¶¶164-65. This provides *orthogonal frequency division multiple access* for the users. This is the point of Galda’s “OFDM-FDMA” scheme, which stands for “orthogonal frequency division-frequency division multiple access.” EX1004, p.1737 (referring to scheme as a “OFDM-FDMA multiple access scheme”); EX1002, ¶165.

Thus, Galda discloses and renders obvious claim 9.

4. Claim 10

Galda discloses and renders obvious *wherein an m^{th} one of the plurality of complex-valued codes is expressed as a set of N code chips, wherein each code chip is expressed by $e^{i2\pi nm/N}$, where e is Euler’s number, i is the square root of -1 , π is Pi, and n is an integer.* EX1002, ¶¶167-71.

As explained in connection with Limitations [1A] and [1E], Galda teaches complex-valued codes of the form $C_{i,j} = \frac{1}{\sqrt{L}} e^{j\pi i j / L}$. *Supra* §§IX.A.1.b, IX.A.1.f; EX1004, p.1739. In the nomenclature of the claim the index j (at the end of Galda’s expression) is the same as the “ m^{th} ” one of the *plurality of complex-valued codes*

because Galda describes “ L orthogonal code vectors $\vec{C}_l = (C_{l,0}, C_{l,1}, \dots, C_{l,l})$ with $l = 0, \dots, L - 1$ ” and instead of indices l and v from equation (2), Galda uses indices i and j in equation (6). EX1004, pp.1738, 1739; EX1002, ¶¶168-69. The code is *expressed as a set of N code chips*, where Galda uses L instead of N as shown in the denominator of the exponential term. And, *each code chip is expressed by $e^{i2\pi nm/N}$* – namely Galda’s expression $C_{i,j} = \frac{1}{\sqrt{L}} e^{j\pi i j / L}$ where e is Euler’s number, j (which is also denoted as i) is $\sqrt{-1}$, π is Pi and n (i in Galda) is an integer from 0 to $L-1$. EX1002, ¶170; EX1004, pp.1738, 1739.

Therefore, Galda discloses and renders obvious claim 10.

B. Ground 3: Claims 13, 18, 21, 22, 25, 30, 33, and 34 are obvious over Galda in view of Dowling

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

Ground 3 relies on Galda in view of Dowling and addresses claims 13, 18, 19, 21, 22, 25, 30, and 31. Claims 13, 18, and 19 require “*at least one processor*” [13A] and “*at least one non-transitory computer-readable memory in electronic communication with the at least one processor, wherein instructions stored in the at least one non-transitory computer-readable memory are executable by the at least one processor*” [13B]. Similarly, claims 25, 30, and 31 require “*at least one non-transitory computer-readable memory having computer-readable program code*

stored thereon, the computer-readable program code containing instructions executable by one or more processors” [25Pre]. Otherwise, these claims correspond to claims 1, 6, 9, and 10, as shown above in the Listing of Claims and further below.

While these claims require computer instructions stored in memory, Galda does not explicitly state whether the disclosed system is implemented in hardware or a combination of hardware and software. EX1002, ¶¶172-73. Nevertheless, a POSITA would have understood that Galda would have needed to be implemented using at least one of these technologies. *Id.* 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. *Id.*

A POSITA knew that transmitters could be implemented in hardware or software. For example, 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 from memory to a processor for execution as was well known to a POSITA. EX1002, ¶¶174-75. Indeed, those skilled in the art were aware of “software radios”

that used code in memory and processors to execute that code to provide flexibility in design and updating, as opposed to hardware which was significantly more difficult to upgrade because it is fixed in silicon. EX1002, ¶175; EX1008 (describing OFDM-CDMA software radio); EX1011, ¶¶[0124]-[0125] (noting that modulation “and other techniques” can be implemented in “hardware, software, or a combination thereof”).

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, ¶¶176-77.

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. Implementing these mathematical operations in software would have required only routine knowledge because software is especially well-suited for performing mathematical operations. EX1002, ¶178. Given the number of disclosures indicating that those in the field were aware that various transmitter functions were able to be implemented in either hardware or software—two known alternatives—a POSITA would have reasonably expected in achieving a software implementation using instructions stored on a memory for execution by a processor. *Id.*

2. *Claims 13 and 25*

- a. [13Pre], [13A], [13B], [25Pre]: An apparatus; computer program product

Galda in view of Dowling renders obvious the following aspects of claims 13 and 25:

[13Pre] An apparatus for communication in a wireless network, comprising: [13A] at least one processor; and [13B] at least one non-transitory computer-readable memory in electronic communication with the at least one processor, wherein instructions stored in the at least one non-transitory computer-readable memory are executable by the at least one processor for:

[25Pre] A computer program product, comprising at least

one non-transitory computer-readable memory having computer-readable program code stored thereon, the computer-readable program code containing instructions executable by one or more processors for:

EX1002, ¶¶179-83.

Galda discloses and renders obvious an apparatus for communication in a wireless network as recited in [13Pre] for the reasons explained in connection with [1Pre], above. *Supra* §IX.A.1.a.

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.*, 5:66-6:1 (disclosing that the transmitter, receiver, and precoder may be implemented in hardware or software); 21:62-64 (disclosing that the “present invention” is applicable to FFT based multicarrier modulation and OFDM systems). In a software implementation, software is stored in *memory*, and is provided from memory to a *processor* for execution. EX1002, ¶¶179-82. This software is *computer-readable program code* and the memory is a *computer-readable memory* because it can be read by a *processor* to obtain the software code for execution. 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, ¶¶181-

82; EX1008 (describing OFDM-CDMA software radio); EX1011, ¶¶[0124]-[0125] (modulation can be implemented in “hardware, software, or a combination thereof”). For the reasons already 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 13 and 25. *Supra* §IX.B.1.

Thus, Galda in view of Dowling discloses and renders obvious limitations [13Pre], [13A], [13B], [25Pre].

b. [13Ci], [25A]: producing subcarrier values

Limitations [13Ci] and [25A] are the same as Limitation [1A]. *Supra* §IX.A.1.b; EX1002, ¶184. Limitations [13Ci] and [25A] are disclosed and rendered obvious by Galda for same reasons as Limitation [1A]. *Id.* It would have been obvious to implement the functionality recited in this limitation in software stored in memory for execution by a processor for the reasons provided above based on Galda in view of Dowling. *Supra* §IX.B.1.

c. [13Cii], [25B]: selecting subcarriers

Limitations [13Cii] and [25B] are the same as Limitation [1B]. *Supra* §IX.A.1.c; EX1002, ¶185. Limitations [13Cii] and [25B] are obvious for same reasons as Limitation [1B]. *Id.* It would have been obvious to implement the functionality recited in this limitation in software stored in memory for execution by a processor for the reasons provided above based on Galda in view of Dowling.

Supra §IX.B.1.

d. [13Ciii], [25C]: modulating values onto subcarriers

Limitations [13Ciii] and [25C] are the same as Limitation [1C]. *Supra* §IX.A.1.d; EX1002, ¶186. Limitations [13Ciii] and [25C] are disclosed and rendered obvious by Galda for same reasons as Limitation [1C]. *Id.* It would have been obvious to implement the functionality recited in this limitation in software stored in memory for execution by a processor for the reasons provided above based on Galda in view of Dowling. *Supra* §IX.B.1.

e. [13Civ], [25D]: producing time-domain waveform

Limitations [13Civ] and [25D] are the same as Limitation [1D]. *Supra* §IX.A.1.e; EX1002, ¶187. Limitations [13Civ] and [25D] are disclosed and rendered obvious by Galda for same reasons as Limitation [1D]. *Id.* It would have been obvious to implement the functionality recited in this limitation in software stored in memory for execution by a processor for the reasons provided above based on Galda in view of Dowling. *Supra* §IX.B.1.

f. [13Cv], [25E]: interference patterns of the superposition and a plurality of cyclic-shifted waveforms

Limitations [13Cv] and [25E] are the same as Limitation [1E]. *Supra* §IX.A.1.f; EX1002, ¶188. Limitations [13Cv] and [25E] are disclosed and rendered obvious by Galda for same reasons as Limitation [1E]. *Id.* It would have been obvious to implement the functionality recited in this limitation in software stored

in memory for execution by a processor for the reasons provided above based on Galda in view of Dowling. *Supra* §IX.B.1.

Thus, Galda in view of Dowling renders obvious claims 13 and 25.

3. *Claims 18 and 30*

Claims 18 and 30 are the same as claim 6. *Supra* §IX.A.2; EX1002, ¶¶190-91. Accordingly, Galda discloses and renders obvious claims 18 and 30 for the same reasons provided with respect to claim 6. *Supra* §IX.B.1. Galda in view of Dowling thus renders obvious claims 18 and 30.

4. *Claims 21 and 33*

Claims 21 and 33 are the same as claim 9. *Supra* §IX.A.3; EX1002, ¶¶192-93. Accordingly, Galda discloses and renders obvious claims 18 and 30 for the same reasons provided with respect to claim 9. *Supra* §IX.A.3. Galda in view of Dowling thus renders obvious claims 21 and 33.

5. *Claims 22 and 34*

Claims 22 and 34 are the same as claim 10. *Supra* §IX.A.4; EX1002, ¶¶194-95. Accordingly, Galda discloses and renders obvious claims 22 and 34 for the same reasons provided with respect to claim 10. *Supra* §IX.B.1. Galda in view of Dowling thus renders obvious claims 22 and 34.

C. Ground 4: Claim 7 is obvious over Galda in view of Doufexi;

Ground 5: Claims 19 and 31 are also obvious over Galda in view of Dowling and further in view of Doufexi;

Ground 6: Claim 7 is obvious over Galda in view of Lucent;

Ground 7: Claim 19 and 31 are obvious over Galda in view of Dowling and further in view of Lucent;

Ground 8: Claim 7 is obvious over Galda in view of Ma;

Ground 9: Claims 19 and 31 are obvious over Galda in view of Dowling and further in view of Ma.

1. Overview of the combinations; motivations to combine; expectation of success

Grounds 4, 6, and 8 rely on Galda as applied to claim 1, above. *Supra* §IX.A.1. Grounds 5, 7, and 9 rely on the combination of Galda and Dowling as applied to claims 13 and 25, above. *Supra* §IX.B.2. These grounds are treated together because they present similar issues. Claims 19 and 31 use the same language as claim 7. And, Doufexi, Lucent, and Ma all describe the benefits of having systems that support variable subcarrier spacings.⁶

Galda explains that “[t]he FDMA multiple access scheme offers not only a high flexibility for radio resource management (RRM) but can also increase the

⁶ To the extent that the Board determines that the ’005 Patent is entitled to a priority date that removes Ma as a prior art reference, Petitioner relies upon Lucent and Doufexi, which provide similar teachings and qualify as prior art even assuming the earliest priority date for the ’005 Patent.

bandwidth efficiency of the complete system by avoiding the use of highly attenuated subcarriers for specific users based on the knowledge of the channel transfer function.” EX1004, p.1737. Galda does not explain what its subcarrier spacing is or state whether it is fixed or variable. EX1002, ¶¶196, 210, 224.

A POSITA knew that there were benefits to using variable sub-carrier spacings in OFDM communications systems. These benefits are revealed in each of Doufexi, Lucent, and Ma.

Doufexi explains that “OFDM is proposed as being a leading candidate for a 4G cellular communications standard.” EX1003, p.192. “[K]ey design considerations and link parameters for a 4G OFDM system are identified” including “subchannel spacing.” *Id.* Doufexi motivates a POSITA to use selectable link parameters: “Since 4G systems will be deployed in a wide range of environments, a fixed set of parameters is not capable of achieving high performance in all cases.” *Id.*; EX1002, ¶¶197-98. “A system capable of dynamically adapting one or more of the above parameters may offer superior performance.” EX1003, p.192; EX1002, ¶198. Thus, Doufexi provides different “parameters and transmission modes” shown in the following table:

Table 2. OFDM Parameters for 4G.

Parameter	Value 1	Value 2
Operating Frequency	2GHz	2GHz
Bandwidth (B)	4096 kHz	4096 kHz
Useful Symbol Duration (T)	62.5 μ s	125 μ s
Guard Interval Duration (T_g)	15.625 μ s ($T/4$)	31.25 μ s ($T/4$)
Total Symbol Duration (T_{symbol})	78.125 μ s (with $GI = T/4$)	156.25 μ s (with $GI = T/4$)
Inner Channel Coding	Punctured 1/2 rate convolution code, Constraint length 7, {133, 171} _{octal}	Punctured 1/2 rate convolution code, Constraint length 7, {133, 171} _{octal}
FFT Size	256	512
Number of data sub-carriers (N_D)	216	432
Sub-carrier spacing (Δ_f)	16 kHz	8 kHz

EX1003, p.193. As shown here, various parameters are adjusted including “sub-carrier spacing (Δ_f).” *Id.*; EX1002, ¶¶198-200. Thus, Doufexi motivates a POSITA to have a system in which the subcarrier spacing can be selected from among a plurality of subcarrier spacings. EX1002, ¶200. Such a capability can provide a system that achieves “high performance” in “a wide range of environments” and “superior performance.” EX1003, pp.192-193; EX1002, ¶200. Thus, a POSITA would have been motivated to allow Galda’s system and method to select one of a plurality of selectable subcarrier spacings based on Doufexi.

Lucent, a submission to 3GPP by Lucent, provides a proposal for a “[b]aseline OFDM [s]ystem[] for [s]tudy.” EX1006, p.1. Lucent provides “three reference configurations” for the proposed “baseline OFDM system.” EX1006, p.5. These are shown in the table below:

System Parameters	Configuration 1	Configuration 2	Configuration 3
Suitable deployment environment	Indoor, Pedestrian A	Vehicular A	Pedestrian B
Symbol per 0.67 msec time slot	12	6	3
Number of FFT points	256	512	1024
Number of sub-carriers	256	512	1024
OFDM Symbol period (usec)	55.6	111	222
Sub-carrier spacing (kHz)	19.2	9.6	4.8
Guard band on each side of the 5MHz band (kHz)	42.4	42.4	42.4
Sampling period (usec)	0.20345025	0.20345025	0.20345025
Guard time $T_g = T_{prefix} + T_{postfix}$ (samples/usec)	17/3.46	34/6.92	68/13.8
Cyclic prefix length (samples/usec)	5/1.017252604	16/3.255204	50/10.17252604
Power amplifier ramp-up and ramp-down period (samples)	6 samples each	9 samples each	9 samples each

EX1006, p.5. Lucent explains that the different configurations are associated with different “suitable deployment environment[s].” *Id.*; *see also id.*, p.7 (“We have suggested an OFDM system with multiple configurations that can be deployed in different environments.”). One difference between the three configurations proposed by Lucent is the subcarrier spacing. There are three options: 19.2 kHz, 9.6 kHz, and 4.8 kHz. *Id.* Lucent thus reflects a similar theme to that found in Doufexi—different use cases call for different subcarrier spacings and other transmission parameters. EX1002, ¶¶211-13. A POSITA knew that a user may have a mobile station (e.g., a UE) that was used in each of the scenarios. EX1002, ¶214. For example, a user may be in a car moving at 100 km/h (configuration 2), stop and get out of the car and

walk across a parking lot (configuration 3), and then enter a building (configuration 1). EX1002, ¶214. Thus, each of these configurations may provide better performance than the others depending on the environment in which the UE is located. EX1002, ¶214. Thus, a POSITA would have been motivated to allow Galda's system and method to select one of a plurality of selectable subcarrier spacings based on Lucent.

Ma describes systems and methods for implementing variable subcarrier spacings and symbol durations in OFDM systems. EX1033, ¶[0002]. Ma partitions frequency and time planes into "multiple access block" ("MAB") regions where each MAB has a different subcarrier spacing and symbol duration. *Id.*, ¶¶[0004], [0028], [0030]-[0031], Fig. 5. Ma's flexible subcarrier spacings and symbol durations "may aid in mitigating problems associated with fixed subcarrier spacing and fixed symbol duration." EX1033, ¶[0028]. Ma's technique can allow parameters to be "selected to meet performance and efficiency demands" thus providing "higher spectral efficiency, greater flexibility, and shorter latencies than is otherwise provided by static sub-carrier spacing and symbol duration allocation of conventional OFDM schemes." *Id.*, ¶[0036]. Therefore, Ma provides explicit motivation for a POSITA to employ flexible subcarrier spacings in Galda's systems and methods. EX1002, ¶¶225-27.

Based on the foregoing a POSITA would have found it obvious to select *one*

of the plurality of subcarrier spacings when selecting the subcarriers for Galda's user because the prior art provides express motivation to do so. EX1002, ¶¶201, 213-15, 228. A POSITA would have seen benefits in configuring Galda to select one of a plurality of subcarrier spacings when selecting a user's subcarrier including (1) achieving "high" or "superior" performance in "a wide range of environments" as stated by Doufexi, (2) enabling different configurations for different UE environments as taught by Lucent, and (3) providing for "higher spectral efficiency, greater flexibility, and shorter latencies" in various scenarios as taught by Ma. EX1002, ¶¶201, 214, 228.

Additionally, a POSITA would have found it obvious to select from a plurality of subcarrier spacings when selecting a user m 's subcarriers in Galda because doing so was one of two possible choices: either employ a fixed subcarrier spacing or employ a variable or selectable subcarrier spacing. EX1002, ¶¶201, 215, 229. And, there were known benefits of providing for selectable subcarrier spacings as outlined above. *Id.*

Using the selectable subcarrier spacings and permitting Galda to select them as part of selecting the set of subcarriers for a particular user (m) would have merely used a known technique of using selectable subcarrier spacings as in each of Doufexi, Lucent, and Ma to improve Galda by allowing it to be adaptable to different environments and deployment scenarios thus increasing system flexibility. EX1002,

¶¶202, 216, 230. The results of the combination would have been predictable because various system parameters would be adjusted to permit either a larger or smaller subcarrier spacing and symbol duration thus improving performance depending on the channel conditions. *Id.*

A POSITA would have reasonably expected to succeed in making the combination because POSITAs were aware of the benefits of selecting different subcarrier spacings depending on channel conditions, deployment scenarios, and/or environmental conditions. EX1002, ¶¶203, 217, 230. A POSITA was also aware of the mathematical relationships between OFDM symbol duration and subcarrier spacing that are needed to maintain orthogonality. EX1002, ¶¶203, 218, 230; EX1015, p.22 (“[T]he carriers are linearly independent (i.e., orthogonal) if the carrier spacing is a multiple of $1/T$.”). These parameters were commonly considered by a POSITA in OFDM system design and this was textbook knowledge. EX1015, p.33 (“In OFDM systems design, a number of parameters are up for consideration, such as the number of subcarriers, guard time, symbol duration, subcarrier spacing, ...”).

2. Claim 7

Galda in view of (1) Doufexi (Ground 4), (2) Lucent (Ground 6), or (3) Ma (Ground 8) renders obvious *wherein selecting the set of subcarriers* (Galda’s process of mapping “ L complex transmit symbols $S_l^{(m)}$ ” to subcarriers *comprises selecting*

one of a plurality of selectable subcarrier spacings (includes selecting a subcarrier frequency spacing as taught by Doufexi, Lucent, or Ma). EX1002, ¶¶204-07, 219-221, 231-33.

Galda does not say that when the set of subcarriers are selected the subcarrier spacing is selected or not. Each of Doufexi, Lucent, and Ma describe selectable subcarrier spacings.

Doufexi: Doufexi describes two OFDM transmission modes with different parameter values including two different subcarrier spacings—i.e., *a plurality of selectable subcarrier spacings*—namely subcarrier spacings (Δ_f) of 16 kHz and 8kHz as shown in the table highlighted below:

Table 2. OFDM Parameters for 4G.

Parameter	Value 1	Value 2
Operating Frequency	2GHz	2GHz
Bandwidth (B)	4096 kHz	4096 kHz
Useful Symbol Duration (T)	62.5 μ s	125 μ s
Guard Interval Duration (T_g)	15.625 μ s ($T/4$)	31.25 μ s ($T/4$)
Total Symbol Duration (T_{symbol})	78.125 μ s (with $GI = T/4$)	156.25 μ s (with $GI = T/4$)
Inner Channel Coding	Punctured 1/2 rate convolution code, Constraint length 7, {133, 171} _{octal}	Punctured 1/2 rate convolution code, Constraint length 7, {133, 171} _{octal}
FFT Size	256	512
Number of data sub-carriers (N_D)	216	432
Sub-carrier spacing (Δ_f)	16 kHz	8 kHz

EX1003, p.193; EX1002, ¶¶204-07.

Lucent: Lucent describes three OFDM system configurations that use three different subcarrier spacings—i.e., 19.2 kHz, 9.6 kHz, and 4.8 kHz. EX1006, p.5; EX1002, ¶212. Thus, Lucent teaches *a plurality of selectable subcarrier spacings*. This is shown in the table below:

System Parameters	Configuration 1	Configuration 2	Configuration 3
Suitable deployment environment	Indoor, Pedestrian A	Vehicular A	Pedestrian B
Symbol per 0.67 msec time slot	12	6	3
Number of FFT points	256	512	1024
Number of sub-carriers	256	512	1024
OFDM Symbol period (usec)	55.6	111	222
Sub-carrier spacing (kHz)	19.2	9.6	4.8
Guard band on each side of the 5MHz band (kHz)	42.4	42.4	42.4
Sampling period (usec)	0.20345025	0.20345025	0.20345025
Guard time $T_g = T_{prefix} + T_{postfix}$ (samples/usec)	17/3.46	34/6.92	68/13.8
Cyclic prefix length (samples/usec)	5/1.017252604	16/3.255204	50/10.17252604
Power amplifier ramp-up and ramp-down period (samples)	6 samples each	9 samples each	9 samples each

EX1006, p.5; EX1002, ¶¶219-21.

Ma: Ma describes “methods for supporting variable sub-carrier spacing and symbol duration for transmitting OFDM symbols and associated cyclic prefixes.” EX1033, ¶[0024]. “The flexible sub-carrier spacing and symbol duration allocation (e.g., corresponding to various MAB [multiple access block] types) may be defined by various OFDM parameters (or frequency primitives), such as subcarrier-spacing, useful symbol length, cyclic prefix length, or combinations thereof.” *Id.*, ¶[0031]. In one embodiment, Ma describes subcarrier spacings of Δf , $2\Delta f$, and $4\Delta f$, where Δf is 15kHz. *Id.* Thus, Ma discloses *a plurality of selectable subcarrier spacings* (e.g., 15 KHz, 30 kHz, and 60 kHz). EX1002, ¶¶231-33.

Based on these teachings and for the reasons explained above, a POSITA would have found it obvious to modify Galda to perform a step of *selecting the set of subcarriers comprises selecting one of a plurality of selectable subcarrier spacings* based on Doufexi, Lucent, or Ma. *Supra* §IX.C.1.

3. *Claims 19 and 31*

Claims 19 and 31 are the same as claim 7. *Supra* §IX.C.2; EX1002, ¶¶208-09, 222-23, 234-35 (providing a claim chart comparing the claims). Accordingly, Galda in view of Doufexi, Lucent, or Ma renders obvious claims 22 and 34 for the same reasons provided with respect to claim 7. *Supra* §IX.C.2. Galda in view of Dowling and further in view of Doufexi (Ground 5) or further in view of Lucent (Ground 7) or further in view of Ma (Ground 9) thus renders obvious claims 19 and 31.

D. Ground 10: Claim 11 is obvious over Galda in view of Bury;

Ground 11: Claims 23 and 35 are obvious over Galda in view of Dowling and further in view of Bury

1. *Claim 11 (Ground 10)*

Galda in view of Bury renders obvious *wherein producing the set of subcarrier values employs a fast transform*. EX1002, ¶¶236-41.

Galda discloses a DFT for DFT spreading. *Supra* §IX.A.1.b (Limitation [1A]). Galda does not explicitly state that its DFT is a FFT or *employs a fast transform*. Bury employs “a DFT for spreading, which can be implemented efficiently as a fast

Fourier transform (FFT),” which *employs a fast transform*. EX1007, p.857; EX1002, ¶238. 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 (a *fast transform*) 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, ¶¶239-40.

Thus, Galda in view of Bury renders obvious claim 11.

2. *Claims 23 and 35 (Ground 11)*

Claims 23 and 35 are the same as claim 11. *Supra* §IX.D.1; EX1002, ¶¶242-43. Accordingly, Galda in view of Bury renders obvious claims 23 and 35 for the same reasons provided with respect to claim 11. *Supra* §IX.D.1. Galda in view of Dowling and further in view of Bury thus renders obvious claims 23 and 35.

X. DISCRETIONARY DENIAL UNWARRANTED⁷

A. *Fintiv* Factors Favor Institution

The *Fintiv* factors—as applied per the March 24, 2025 Guidance on the

⁷ Petitioner presents these arguments without waiving additional briefing under the USPTO’s March 26, 2025 “Interim Process for Workload Management.”

USPTO rescission of the Interim Procedure (EX1060, “Boalick Memo”) guides against discretionary denial. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (Mar. 20, 2020) (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, Paper 16, at 10 (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, Paper 12, at 17 (Feb. 16, 2021) (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, at 17-18 (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.*, IPR2020-01019, Paper 12, at 19 (Dec. 1, 2020) (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*, IPR2020-01445, Paper 12 at 16 (“*Fintiv* factor 4 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. EX1088. This is the first and only IPR on the ’005 Patent, so a patentability determination by the Board on this Petition would conserve resources.

B. Denial Under §325(d) Unwarranted

The ’005 Patent was not rejected on any prior art, and the prior art in Petitioner’s Grounds was not mentioned or otherwise discussed by the Examiner during prosecution. Therefore, denial under § 325(d) is unwarranted.

XI. 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 ’005 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:** *Samsung Electronics Co., Ltd. v. GenghisComm Holdings, LLC*, IPR2025-00781.
- **U.S. Patent No. 10,389,568:** *Samsung Electronics Co., Ltd. v. GenghisComm Holdings, LLC*, IPR2025-00788.
- **U.S. Patent No. 11,075,786:** *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. 11,381,285:** *Samsung Electronics Co., Ltd. v. GenghisComm Holdings, LLC*, IPR2025-00792; Petitioner also anticipates filing a request for reexamination as to this patent to raise grounds that cannot be raised in this proceeding.

- **U.S. Patent No. 11,424,792:** U.S. Reexamination Control No. 90/019,848; *Samsung Electronics Co., Ltd. v. GenghisComm Holdings, LLC*, IPR2025-00793.

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

C. Lead and Back-Up Counsel

Petitioner designates the following lead and back-up counsel:

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D. Service

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

XII. FEES

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

Dated: April 7, 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 11,579 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 7, 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 7th, 2025, I caused a true and correct copy of **PETITION FOR *INTER PARTES* REVIEW OF CLAIMS 1, 6, 7, 9, 10, 11, 13, 18, 19, 21, 22, 23, 25, 30, 31, 33, 34 AND 35 OF U.S. PATENT NO. 11,252,005, PETITIONER’S POWER OF ATTORNEY BY SAMSUNG ELECTRONICS CO., LTD., PETITIONER’S POWER OF ATTORNEY BY SAMSUNG ELECTRONICS AMERICA, INC., AND EXHIBIT NOS. 1001-1005, 1006-1017, 1019, 1021, 1023, 1030-1034, 1036-1039, 1042, 1046-1047, 1052, 1059-1069, 1080-1088** by EXPRESS MAIL on the Patent Owner at the correspondence address of record for U.S. Patent No. 11,252,005 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