

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GOOGLE LLC, CELLCO PARTNERSHIP D/B/A VERIZON WIRELESS, T-MOBILE USA, INC., AT&T SERVICES, INC., NOKIA OF AMERICA, CORP.,
AND ERICSSON INC.

Petitioners

v.

KT CORPORATION (Patent Owner) and
PEGASUS WIRELESS INNOVATION LLC (Exclusive Licensee)

Case No. IPR2025-00291

Patent 10,594,460

**PETITION FOR INTER PARTES REVIEW
OF U.S. PATENT NO. 10,594,460**

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I. INTRODUCTION

Google LLC, Cellco Partnership d/b/a Verizon Wireless, T-Mobile USA, Inc., AT&T Services, Inc., Nokia of America, Corp., and Ericsson Inc. (collectively, “Petitioners”) respectfully request *inter partes* review of Claims 1-12 (“the Challenged Claims”) of U.S. Patent 10,594,460 (“the ’460 Patent”) (EX1001) under 35 U.S.C. §§311-319 and 37 C.F.R. §42.100 *et seq.*

The ’460 Patent purports to promote efficient communication between user equipment (“UE”, *e.g.*, mobile device) and a base station (“BS”, *e.g.*, cellular tower) by performing frequency hopping or switching between different frequency channels in a fifth generation (“5G”) access network. The Challenged Claims recite “a frequency hopping offset set composed of one or more frequency hopping offset values”. The prior art cited herein expressly discloses this feature, which was relied upon for allowance. The prior art includes intervening prior art to Shen (EX1013, Grounds 1-2), Matsumura (EX1019, Grounds 2-3), R1-1801080 (EX1017, Grounds 2-3), and Zhang (EX1020, Ground 3), given the ’460 Patent’s lack of entitlement to its earliest foreign priority dates. The prior art also includes non-intervening prior art to Yin (EX1021, EX1022, Ground 4), TS 36.211 (EX1024), TS 36.213 (EX1025), and Jersenius (EX1023). All Challenged Claims are therefore unpatentable.

II. MANDATORY NOTICES PURSUANT TO 37 C.F.R. §42.8(a)(1)

A. Real Party-In-Interest

Pursuant to 37 C.F.R. §42.8(b)(1), Petitioners certify that the real parties in interest are Google LLC¹, Cellco Partnership d/b/a Verizon Wireless, Verizon Business Network Services LLC, Verizon Corporate Services Group Inc., TracFone Wireless, Inc., AT&T Corp., AT&T Services, Inc., AT&T Mobility LLC, AT&T Mobility II LLC, New Cingular Wireless PCS, LLC, Cricket Wireless LLC, T-Mobile USA, Inc., Sprint Solutions LLC, Sprint Spectrum LLC, Ericsson Inc., Telefonaktiebolaget LM Ericsson, and Nokia of America Corporation.

Out of an abundance of caution, Petitioners identify all current defendants in the below cases, as well as additional involved parties, as potential real parties in interest only for the purpose of this proceeding and only to the extent that Patent Owner contends that these separate legal entities should be named real parties in interest in this IPR. Petitioners do so to avoid the potential expenditure of resources to resolve such a challenge. Petitioners also acknowledge that each petitioner has a number of affiliates. No unnamed entity is funding, controlling, or otherwise has an

¹ Google LLC is a subsidiary of XXVI Holdings Inc. which is a subsidiary of Alphabet Inc. XXVI Holdings Inc. and Alphabet Inc. are not real parties-in-interest to this proceeding.

opportunity to control or direct this Petition or Petitioners' participation in any resulting IPR. Petitioners are also not aware of any affiliate that would be barred from filing this Petition under 35 U.S.C. §315(e).

B. Identification of Related Matters Under 37 C.F.R. §42.8(b)(2)

The following is a list of any judicial or administrative matters that would affect, or be affected by, a decision in this proceeding:

Related District Court Matters ("Related Litigations")

1. *Pegasus Wireless Innovation LLC v. AT&T Inc. et al.*, Civ. Action No. 2:23-cv-00638 (EDTX) filed on December 29, 2023 (consolidated with 2:23-cv-00640) ("the '638 Litigation");

2. *Pegasus Wireless Innovation LLC v. T-Mobile US, Inc. et al.*, Civ. Action No. 2:23-cv-00639 (EDTX) filed on December 29, 2023 (consolidated with 2:23-cv-00640) ("the '639 Litigation"); and

3. *Pegasus Wireless Innovation LLC v. Verizon Communications Inc. et al.*, Civ. Action No. 2:23-cv-00640 (EDTX) filed on December 29, 2023 (pending) ("the '640 Litigation").

Related Applications

The '460 Patent issued from U.S. Patent Application No. 16/048,210, filed on July 27, 2018, and claims priority to Korean Patent Application No. 10-2017-0095980, filed on July 28, 2017 (the "'980 Application") (EX1008, EX1009),

Korean Patent Application No. 10-2017-0102577, filed on August 11, 2017 (the “577 Application”) (EX1005, EX1006), and Korean Patent Application No. 10-2018-0057278, filed on May 18, 2018 (the “278 Application”) (EX1003, EX1004).

C. Lead and Backup Counsel

Pursuant to 37 C.F.R. §42.8(b)(3) and §42.10(a), Petitioners hereby identify its lead and backup counsel as follows:

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Powers of Attorney are being filed concurrently herewith in accordance with 37 C.F.R. §42.10(b).

D. Service Information Under 37 C.F.R. §42.8(b)(4)

Petitioners consent to electronic service at the email addresses listed above.

III. FEES

The undersigned authorizes the Office to charge Deposit Account 02-4800 for fees required by 37 C.F.R. §42.15(a).

IV. REQUIREMENTS UNDER 37 C.F.R. §42.104

A. Grounds for Standing

Petitioners certify that the '460 Patent is available for IPR and Petitioners are not barred or estopped from requesting an IPR of the Challenged Claims on the grounds identified herein. 37 C.F.R. §42.104(a).

B. Identification of Challenges and Precise Relief Requested

Petitioners challenge Claims 1-12 of the '460 Patent and request that these claims be found unpatentable for the reasons set forth in Petitioners' Grounds:

Ground	Reference(s)	Basis	Claims
1	WO2019/136597 ("Shen") (EXs1012-1013)	§102/§103	1, 3, 5, 7, 9, 11
2	Shen in view of WO2019/097659 ("Matsumura") (EXs1018-1019) and NTT-DOCOMO (R1-1801080) (EX1017)	§103	2, 4, 6, 8, 10, and 12
3	WO2018/203727 ("Zhang") (EX1020) optionally in view of Matsumura and R1-1801080	§102/§103	1-12
4	WO2018/129085 ("Yin") (EX1021); 3GPP TS 36.211 ("TS 36.211") (EX1024); 3GPP TS 36.213 ("TS 36.213") (EX1025) optionally in view of US 2013/0322493 ("Jersenius") (EX1023)	§103	1-12

Unless otherwise noted, citations to Shen and Matsumura herein are to the Certified English Translations (EX1013 and EX1019, respectively).²

Petitioners also rely upon the evidence listed in the Appendix A, including the Declaration and *Curriculum Vitae* of Petitioners' expert, Mark Lanning

² Citations to EX1013 and EX1019 are to page numbers at the bottom of each page, *e.g.*, "Page 1 of 30."

(EX1031, ¶¶1-357; EX1032) and the Declaration and *Curriculum Vitae* of Craig Bishop (EX1033, ¶¶1-72; EX1034).

C. Prior Art Qualification of Asserted References

This Petition cites Intervening Prior Art (Grounds 1-3) and Non-Intervening Prior Art (Ground 4).

Intervening Prior Art

As discussed in §V.C., the Challenged Claims are not entitled to a priority date before May 18, 2018.

Shen (EXs1012-1013), filed January 9, 2018, constitutes prior art at least under §102(a)(2).

Matsumura (EXs1018-1019), filed November 16, 2017, constitutes prior art at least under §102(a)(2).

Zhang (EX1020), filed May 4, 2018, constitutes prior art at least under §102(a)(2).

R1-1801080 (EX1017), published January 26, 2018, constitutes prior art at least under §102(a)(1).

Non-Intervening Prior Art

Yin (EX1021), filed January 3, 2018, claims priority to U.S. Provisional Application 62/442,864 (EX1022, “Yin ’864”), filed January 5, 2017, and constitutes prior art at least under §102(a)(2) because citations to Yin (EX1021) in

this Petition and Mr. Lanning's Declaration (EX1031) are supported by corresponding disclosure in Yin '864 (EX1022).

Yin incorporates Yin '864 by reference. EX1021, ¶[0001]. M.P.E.P. (8th Ed) §2163.07(b) ("information incorporated ... should be treated as part of the text of the application as filed"); *Apple Inc. v. Koss Corporation*, IPR2021- 00255, Paper 54 (PTAB May 31, 2022), at 25-30 (holding claims obvious over provisional applications incorporated in their entirety). Thus, Yin '864 should be treated as part of the text of Yin.

Jersenius (EX1023), published December 5, 2013 and filed August 16, 2013,³ constitutes prior art at least under §102(a)(1) and §102(a)(2).

Technical Specification 3GPP TS 36.211, version V11.6.0 (EX1024), published September 2014, and Technical Specification 3GPP TS 36.213, version V11.6.0 (EX1025), published March 2014, constitute prior art at least under §102(a)(1), as confirmed by Petitioners' expert Craig Bishop (EX1033).

3GPP technical specifications ("TS") and contributions were publicly accessible as of their upload date to the 3GPP publicly available file server. EX1033, ¶¶1-72. R1-1801080 (EX1017), TS 36.211 (EX1024), and TS 36.213 (EX1025)

³ Jersenius derives from PCT/SE2011/050173 filed February 17, 2011.

were to 3GPP server on January 26, 2018, in September 2014, and in March 2014, respectively. *Id.* R1-1801080, TS 36.211, and TS 36.213 became “printed publications” under 35 U.S.C. §102 on January 26, 2018, September 2014, and March 2014, respectively. *See, e.g., Samsung Elecs. Co., Ltd. v. Huawei Techs. Co., Ltd.*, IPR2017-01487, Paper 45, at 13-14 (technical reports and specifications uploaded to a standards organization’s file server before a challenged patent’s priority date qualify as prior art under 35 U.S.C. §102) (PTAB Dec. 10, 2018). R1-1801080, TS 36.211, and TS 36.213 therefore qualify as prior art under 35 U.S.C. §102(a)(1).

V. BACKGROUND

A. The ’460 Patent

The ’460 Patent discloses an apparatus and method for performing frequency hopping for an uplink (“UL”) channel transmission and reception in a next generation/fifth generation (“5G”), also referred to as New Radio (“NR”) radio, access network. EX1001, 1:18-23. The frequency hopping uses “frequency hopping configuration information including a frequency hopping offset set which is composed of one or more frequency hopping offset values” for UL control and data channels received from a BS. *Id.*, 12:63-66; 18:36-40. Patent Owner asserts that the ability to perform frequency hopping to transmit UL channels in a 5G network based on bandwidth configuration information and frequency hopping configuration

information received from a BS, constitutes the purported “inventive features” of the ’460 Patent. EX1026, ¶¶146-147, 149. However, as explained in §VII, it was well known to perform frequency hopping to transmit UL channels in a 5G network based on bandwidth configuration information and frequency hopping configuration information received from a BS.

B. Examination History

The ’460 Patent was filed as U.S. Application 16/048,210 on July 27, 2018. EX1002, 275-350. The Patent Office rejected the Challenged Claims based on US 2014/0169316 (“Kim”) (EX1015), US 2012/0250653 (“Zhang ’653”) (EX1014),⁴ and US 2015/0195069 (“Yi”) (EX1016). EX1002, pp.109-124. Applicant responded by amending the independent claims to recite that “the frequency hopping configuration information for a UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values” and “a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by

⁴ Zhang ’653 is unrelated to the Zhang reference cited in this Petition. Zhang lists Yingjie Zhang as the first inventor and is assigned on its face to Samsung Electronics Co., Ltd. Zhang ’653 lists Changsheng Zhang as the first inventor and, according to the USPTO Assignment database, is assigned to ZTE CORPORATION. EX1014.

UL grant downlink control information (DCI)”. *Id.*, pp.91-99. Applicant argued that the applied art does not “teach or disclose receiving frequency hopping configuration information for a UL data channel that ‘includes a frequency hopping offset set composed of one or more frequency hopping offset values.’” *Id.* In particular, Applicant argued that the term “frequency hopping offset set composed of one or more frequency hopping offset values” means that “the claimed frequency hopping offset set includes *multiple* frequency offset values.” *Id.*, p.98, ll.3-9:

As described, Zhang might teach about **the fixed and single frequency offset value**. Such a fixed and single frequency offset value **is different** from the claimed frequency hopping offset **set** composed of multiple frequency hopping offset values. Unlike the fixed and single frequency offset value of Zhang, i) the claimed frequency hopping offset set includes **multiple frequency offset values**, and ii) each frequency offset value included in the frequency hopping offset set **is not a fixed value**. In particular, the frequency hopping offset value is determined **based on a number of physical resource blocks (PRBs) constituting the transmission BWP**.

Id. (emphasis in original).

Applicant expressly disclaimed the “single” frequency hopping offset value and argued that the claims instead require “multiple” frequency hopping offset values in order to distinguish the prior art Zhang ’653, which discloses in paragraph [0040] what Applicant interpreted as a “single” frequency offset during frequency hopping, and secured allowance. The Examiner withdrew the rejection in the next

action indicating that Applicant’s arguments, including Applicant’s interpretation of the term “one or more frequency hopping offset values” as “multiple frequency offset values,” *Id.*, p.99, ll.3-9, were “persuasive in light of the amended claims.” *Id.*, pp.48-58. The application was subsequently allowed.

The prior art cited in this Petition discloses the features alleged to be missing from art applied during prosecution. §VII. EX1031, ¶¶33-327.

C. Patent Owner Is Not Entitled To The Priority Date of Its ’577 and ’980 Applications

As explained below, the Challenged Claims are not entitled to a priority date before May 18, 2018—the latest of the three priority applications.

1. Patent Owner Must Prove Entitlement to an Earlier Priority Date

“[C]laims in a patent or patent application are not entitled to priority under [35 U.S.C.] §120 at least until the patent owner proves entitlement to the PTO, the Board, or a federal court.” *Nat. Alts. Int’l, Inc. v. Iancu*, 904 F.3d 1375, 1381 (Fed. Cir. 2018). Where a patentee seeks to rely upon a priority claim to antedate a prior art reference, the burden is on the patentee to prove entitlement to its asserted earlier priority date. *See Utter v. Hirago*, 845 F.2d 993, 998 (Fed. Cir. 1988).

To meet its burden of establishing priority, Patent Owner must prove that the priority application meets the written description requirement of 35 U.S.C. §112. *Allicrate v. Wadsworth Mfg.*, 427 F.3d 1361, 1373 (Fed. Cir. 2005); *See also In re*

Gosteli, 872 F.2d 1008, 1011 (Fed. Cir. 1989). To provide the required written description of the invention, the disclosure must reasonably convey to a skilled artisan “that the inventor had possession at that time of the later claimed subject matter.” *Vas-Cath Inc. v. Sakharam D. Mahurkar*, 935 F.2d 1555, 1563 (Fed. Cir. 1991). “One shows that one is ‘in possession’ of the invention by describing the invention, ***with all its claimed limitations, not that which makes it obvious.***” *Lockwood v. Am. Airlines, Inc.*, 107 F.3d 1565, 1572 (Fed. Cir. 1997) (emphasis added). “Put another way, one skilled in the art, reading the original disclosure, ***must immediately discern the limitation at issue*** in the claims.” *Purdue Pharma L.P. v. Faulding Inc.*, 230 F.3d 1320, 1323 (Fed. Cir. 2000) (emphasis added). *See also PowerOasis, Inc. v. T-Mobile USA Inc.*, 522 F.3d 1299, 1306 (Fed. Cir. 2008); *Research Corp. Techs., Inc. v. Microsoft Corp.*, 627 F.3d 859, 870 (Fed. Cir. 2010) (“the parent application must actually or inherently disclose the elements of the later-filed claims”). Any claim that depends on any new matter included in a later-filed continuation application is only entitled to the filing date of the later-filed continuation application. *PowerOasis*, 522 F.3d at 1310.

2. Patent Owner Cannot Show That It Is Entitled To Claim Priority To the ’980 and ’577 Applications

The ’460 Patent claims priority to three Korean patent applications. §II.B. Only the ’980 and ’577 Applications predate the Intervening Prior Art (§V.D.1.).

However, the Challenged Claims are not fully supported by the '980 and '577 Applications, as explained below. EX1031, ¶¶45-79.

First, neither the '980 Application nor the '577 Application disclose the limitations in independent Claims 1, 5, and 9 requiring “***transmit[ting] a UL control channel and a UL data channel*** to the BS through the transmission BWP ***based on*** the BWP configuration information and ***the frequency hopping configuration information***” (Claims 1 and 9) or “***receiving the UL control channel and the UL data channel*** from the UE through the reception BWP ***based on*** the BWP configuration information and ***the frequency hopping configuration information***” (Claim 5). EX1001, 13:27-30, 15:4-7; EX1009, ¶¶[0008-0011], [0108-109], [0114], [0119], [0135], [0140], [0158], [0163], [0180], [0185]; EX1010, ¶¶[0009-0011], [0108-109], [0114], [0119], [0135], [0140], [0158], [0163], [0180], [0185]. The terms “frequency hopping configuration information” and “frequency hopping offset set” do not appear in the '980 or the '577 Applications. Further, Figs. 7 and 8 of the '460 Patent, to which the features cited above relate, were disclosed for the

first time in the '278 Application, filed on May 18, 2018. EX1004, p.34; EX1009, ¶¶[0019-20], [0099-141]; EX1010, ¶¶[0019-20], [0099-141].⁵ EX1031, ¶¶46-53.

Petitioners' expert confirms that no other disclosure in the '980 or '577 Applications provides written description support for this claim limitation. EX1031, ¶54.

Second, Applicant obtained allowance by arguing a feature not supported in the earliest priority applications. Neither the '980 Application nor the '577 Application discloses the limitation in Claims 1, 5, and 9 requiring “a frequency hopping offset set composed of one or more frequency hopping offset values” when properly construed (§VI). The '980 and the '577 Applications lack supporting disclosure from the '460 Patent: “Also, the frequency hopping configuration information for a UL data channel may include *a frequency hopping offset set* which is composed of *one or more frequency hopping offset values*.” EX1001, 14:42-46; 16:21-25; 17:65—18:2; EX1009, ¶¶[0114], [0135], [0158], [0180]; EX1010, ¶¶[0114], [0135], [0158], [0180]. Rather, in every embodiment in the '980 and '577

⁵ The '460 Patent rennumbers the original Figs. 7 and 8 of the '980 Application and the '577 Application as Figs. 9 and 10, and rennumbers reference numerals in these figures.

Applications, “the BS/network may dynamically indicate an offset value (e.g., a PRB offset value) from a frequency location of a second hop of a corresponding PUCCH.” EX1008, 15:10-16; EX1006, ¶[0054]. In other words, the ’980 and ’577 Applications merely disclose a *single* offset value. Neither the ’980 nor the ’577 Application discloses any embodiments in which the frequency hopping offset set is composed of *multiple* frequency hopping offset values, as Patent Owner argued during prosecution. §V.B. The features “frequency hopping offset set” and “frequency hopping offset values” were disclosed for the first time in the ’278 Application, filed on May 18, 2018. EX1004, ¶¶[0096-0193]; EX1009, ¶¶[0094-187]; EX1010, ¶¶[0099-187]. EX1031, ¶¶56-65.

In fact, Patent Owner’s proposed claim construction of the limitations “a frequency hopping offset set composed of one or more frequency hopping offset values” cite as extrinsic evidence for the proposed construction 3GPP TS 36.213 V14.4.0⁶ (2017-09), which was published *after* the filing dates of the ’980 and ’577 Applications. EX1027, p.9. Petitioners’ expert confirms that no other disclosure in the ’980 or ’577 Applications provides written description support for this claim limitation. EX1031, ¶112.

⁶ An earlier version of 3GPP TS 36.213 is cited in Petitioners’ Ground 4.

The '980 and '577 Applications mention “candidate values for corresponding hopping offset values”; these “candidate values” are not *frequency* hopping offset values, but instead relate to a “frequency hopping *bandwidth*,” which defines upper and lower bounds (i.e., bandwidth) for frequencies, or the whole bandwidth available to the UE for frequency hopping, for either a bandwidth part or a system bandwidth, not to “frequency hopping offset values.” EX1006, p.14, l.30; EX1008, ¶[0054]. EX1031, ¶¶63-65.

The '980 and '577 Applications also fail to provide written descriptive support for Claims 2-4, 6-8, 10-12. For example, the features “a number of frequency hopping offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the transmission BWP” and “the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less” were disclosed for the first time in the '278 Application, filed on May 18, 2018. EX1004, ¶¶[0096-0193]. Petitioners’ expert confirmed that no other disclosure in the '980 or '577 Applications provides written description support for these claim limitations. EX1031, ¶¶66-78.

Thus, Patent Owner is not entitled to a priority date before the filing date of the '278 Application, May 18, 2018. EX1031, ¶¶45-79.

D. Prior Art

Shen (EX1013), Matsumura (EX1019), R1-1801080 (EX1017), and Zhang (EX1020) (collectively, the “Intervening Prior Art”) cited in Grounds 1-3 qualify as prior art because the Challenged Claims are not entitled to the benefit of the ’980 and ’577 Applications filed July 28, 2017 and August 11, 2017, respectively. §V.C. Even if the Challenged Claims are entitled to the filing date of the ’278 Application filed May 18, 2018, this is not earlier than the effective dates of the Intervening Prior Art (§IV.C.).

Yin (EX1021, EX1022), TS 36.211 (EX1024), TS 36.213 (EX1025), and Jersenius (EX1023) (collectively, the “Non-Intervening Prior Art”) cited in Ground 4 qualify as prior art relative to the earliest claimed filing date of the ’460 Patent, July 28, 2017.

The Challenged Claims are thus unpatentable regardless of whether the ’460 Patent is entitled to its earliest claimed priority dates.

1. Shen (EX1013)

Shen discloses a method for establishing a frequency hopping configuration, by a network device (*e.g.*, base station BS) for a terminal (*e.g.*, user equipment UE), of a Bandwidth Part (“BWP”) in a 5G New Radio (“NR”) system. *See* EX1013 in its entirety; *Id.*, 1:3-10; 5:21-23, 5:26-28, 7:5-8, 8:27-31, 8:36-37, 9:12-14, 13:27-36. EX1031, ¶¶89-92.

2. Matsumura (EX1019)

Matsumura discloses a method for frequency hopping of an uplink control channel (“PUCCH”) and an uplink data channel (“PUSCH”) to configure, per user terminal (UE), an access Bandwidth (“BW”) or a Bandwidth Part (“BWP”) in a carrier, such as a Component Carrier (“CC”) or a system band, in future radio communication systems (*e.g.*, LTE Rel. 14 and 15, 5G, and NR). *See* EX1019 in its entirety; *Id.*, ¶¶[0004-10], [0029-32], [0048-50], [0061-66], [0094]. EX1031, ¶¶93-99.

3. R1-1801080 (EX1017)

R1-1801080 relates to frequency hopping in UL transmission in NR communication systems (*e.g.*, 5G). *See* EX1017 in its entirety; *Id.*, §2.3, p.2/33; §2.4, p.4/33; §4.1.3.2, p.10/33. EX1031, ¶¶100-102.

4. Zhang (EX1020)

Zhang discloses methods for allocating uplink resources, such as Bandwidth Part (“BWP”) resources and intra-BWP Physical Resource Block (“PRB”) resources, from a BS to a UE, and uplink transmission by the UE using the allocated uplink resources, in a 5th-Generation (5G) communication system. *See* EX1020 in its entirety; *Id.*, Abstract, ¶¶[0006-16], [0020-22], [0056], [0163-172], [0210], [0223-227], [0287-295], [0460]; Fig. 5. EX1031, ¶¶103-108.

5. Yin (EX1021)

Yin describes methods for allocating physical uplink control channel (PUCCH) regions or subbands in a 5th generation (5G) new radio (NR) system. EX1021 in its entirety; *Id.*, Abstract, ¶¶[0002], [0006], [0052-54], [0058], [0064], [0085], [0098], [0105], [0216]; EX1022, ¶¶[0044-46], [0050], [0056], [0077], [0090], [0097], [0104-107], [0202]. EX1031, ¶¶109-110.

6. TS 36.211 (EX1024); TS 36.213 (EX1025)

TS 36.211 and TS 36.213 disclose and suggest configuring frequency hopping for the UL data channel (PUSCH). EX1024, §5.3.4, p.22; EX1025, §8.4, pp.114-115. Notably, Patent Owner cited a later version of the same Technical Specification 3GPP TS 36.213 V14.4.0 (2017-09) as an extrinsic evidence for the proposed construction of the limitations “a frequency hopping offset set composed of one or more frequency hopping offset values.” EX1027, p.9. EX1031, ¶¶111-112.

7. Jersenius (EX1023)

Jersenius describes methods for allocating radio resources to UE using Type 1 frequency hopping with three different offset values and Type 2 PUSCH frequency hopping with the PUSCH bandwidth divided into 3 subbands. EX1023 in its entirety; *Id.*, ¶¶[0015], [0040], [0047-48], [0050-51], [0056], [0084]. EX1031, ¶¶113-114.

E. Person of Ordinary Skill in the Art (“POSITA”)

A POSITA pertinent to the ’460 Patent would have had a bachelor’s degree in electrical engineering, computer engineering, or a related discipline, knowledge

of the relevant 3GPP standards as of this time, and at least 2 years of experience working in a field involving wireless communications. EX1031, ¶¶80-82. A person with a different degree, but with additional relevant experience, could still qualify if the additional experience compensates for the different educational background. *Id.* A person with less than 2 years of experience working in a field involving wireless communications could still qualify if the person has additional education that compensates for their lesser experience. *Id.*

VI. CLAIM CONSTRUCTION

The Board only construes the claims when necessary to resolve the underlying controversy. *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

In Related Litigation, Patent Owner proposed that certain claim terms should be given their plain and ordinary meaning. EX1027, pp.9-10. Defendants proposed that the preambles of claims 1, 5, and 9 are limiting. EX1028, pp.19-21. Defendants proposed that the plain and ordinary meaning of “configured to” in claim 9 means “actually configured to and not merely capable of performing the claimed function.” *Id.*, p.23. Defendants proposed construing “a frequency hopping offset set composed of one or more frequency hopping offset values” in claim elements [1.4], [5.4], and [9.4] as:

a frequency hopping offset set composed of multiple frequency hopping offset values.

Id., p.23. This construction is consistent with Applicant’s argument during prosecution requiring “multiple” frequency hopping offset values. §V.B.

Petitioners apply the constructions proposed in the Related Litigation in the Grounds below. While the proper metes and bounds of the claims are disputed in the Related Litigation, the cited prior art falls within these bounds whatever they may be. The Challenged Claims are unpatentable under all potential constructions.

VII. PETITIONERS HAVE A REASONABLE LIKELIHOOD OF PREVAILING

The Challenged Claims are unpatentable over the prior art. EX1031, ¶¶33-327.

A. Claims 1, 3, 5, 7, 9, and 11 Are Anticipated by or Obvious in view of Shen (Ground 1)

1. Claim 1 (Preamble): “A method for a user equipment (UE) to transmit an uplink (UL) control channel and a UL data channel to a base station (BS), the method comprising”

Shen anticipates or renders obvious the Preamble. Shen discloses a method for a user equipment (UE), represented as a “terminal” (EX1013, Abstract, 3:3-4), to transmit an uplink (UL) control channel (i.e., Shen’s “physical uplink control channel (PUCCH)”), and a UL data channel (i.e., Shen’s “physical uplink shared channel (PUSCH)”), to a base station (BS), represented as a “network device” (*Id.*, 3:3-4). EX1013, 5:21-28, 7:5-8. Shen is directed to improving “the transmission

performance of physical channels.” *Id.*, 3:16-17. EX1031, ¶117. Both the ’460 Patent and POSITA recognize PUSCH as a “UL data channel” (UL configured data channel such as “a physical uplink shared channel (PUSCH)”) EX1001, 4:31-34. EX1031, ¶¶118-119. Shen’s “terminal” transmits a physical channel. EX1013, 10:26-27.

a. Element [1.1]: “receiving, from a BS, bandwidth part (BWP) configuration information of a BWP set composed of one or more BWPs configured for a UE;”

Shen anticipates or renders obvious Element [1.1]. Shen discloses receiving from its “network device” (i.e., BS) a bandwidth part (“BWP”) configuration information of a BWP set composed of one or more BWPs configured for its “terminal” (i.e., UE). Shen’s BWP configuration information for its “terminal” (UE) indicates the BWP configuration of at least one BWP of a BWP set. EX1013, 5:21-23 (“first configuration information is used to indicate at least one frequency domain displacement separately configured for each of at least one BWP”); 6:4-6 (“transmit a second configuration information to the terminal ... to indicate the configuration of the at least one BWP”); 9:12-14; Fig. 2B. Shen’s “second configuration information” or “BWP configuration information”, like that of the ’460 Patent, indicates to the UE how to configure at least one BWP and to determine a “position of each of the at least one BWP.” *Id.*, 6:4-6 (“after the terminal *receives* the second configuration information, it can determine the position of each of the at least one

BWP”); EX1031, ¶¶121-127; EX1001, 13:39-42 (BWP configuration information is a “BWP set composed of one or more BWPs configured for the UE.”).

b. Element [1.2]: “receiving, from the BS, frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one transmission BWP of the BWP set; and”

Shen anticipates or renders obvious Element [1.2], as discussed herein and in §VII.A.7, Shen discloses receiving, from its “network device” (BS), frequency hopping configuration information (“at least one frequency domain displacement”, EX1013, 6:17-29) (i.e., “offset” of Fig. 1B) for a UL control channel (Shen’s “PUCCH”) and a UL data channel (Shen’s “PUSCH”). EX1013, 4:14-22, 5:19-31, 6:20-37, Fig. 1A, as confirmed by Petitioners’ expert. EX1031, ¶¶129-130]. Shen’s UL control/data channels (PUCCH/PUSCH) are transmitted through one transmission BWP of the BWP set. *Id.*, 5:26-28, 13:29-34 (“physical channel to be transmitted in the *activated BWP*”). Petitioners note that Element [1.3] *infra* confirms that it is the UL control/data channels (i.e., PUCCH, PUSCH) which are transmitted through the “transmission BWP.”

“[T]he frequency domain displacement information refers to the *frequency domain displacement between two hops of frequency hopping* ... expressed by number of RBs.” EX1013, 8:34-35. EX1031, ¶¶125. The terminal “*receives* a first configuration information ... to indicate at least one frequency domain displacement separately configured for each of at least one BWP” (EX1013, 8:29-31) and

“determines at least one frequency domain displacement for each BWP based on the first configuration information.” *Id.*, 8:32-33. EX1031, ¶¶[129-130].

To the extent Patent Owner argues that the frequency hopping configuration information must be transmitted through one transmission BWP of the BWP set, the ’460 Patent does not support this interpretation, but instead provides: “[t]he UE may be notified of the BWP configuration information and the frequency hopping configuration information through higher layer signaling (e.g., RRC signaling).” EX1001, 15:8-10. Shen similarly teaches frequency hopping configuration information (“frequency domain displacement separately configured for each of at least one BWP”) is transmitted from the BS to the UE using the same “high-level signaling or system broadcast message,” such as “radio resource control (RRC) signaling.” *Id.*, 5:19-37; 6:9-22; Fig. 1A. EX1031, ¶¶133-134. Therefore, Shen teaches that frequency hopping configuration information is transmitted through one transmission BWP of the BWP set using RRC signaling to the same extent disclosed in the ’460 Patent. EX1031, ¶135.

In addition, Shen’s RRC signaling protocol messages, which include downlink control information (DCI) messages (*Id.*, 6:17-22), are transmitted to its “terminal” (UE) over a downlink control channel, such as a Physical Downlink Control Channel (PDCCH), which is one of Shen’s “physical channel[s]” configured for each BWP. *Id.*, 5:19-37. EX1031, ¶136. The RRC signaling protocol messages,

which contain the DCI used by the BS to specify UE configuration parameters, including the frequency hopping configuration, are transmitted on the PDCCH which transmits through the BWP (i.e., inside the BWP frequency range) to the UE. *Id.*, 5:21-37. EX1031, ¶¶137-138. Shen therefore teaches that frequency hopping configuration information is transmitted through one transmission BWP of the BWP set. EX1031, ¶¶138-140. *In re Baxter Travenol Labs.*, 952 F.2d 388, 21 USPQ2d 1281 (Fed. Cir. 1991) (“Testimony from those skilled in the art, through depositions and declarations, and [Patent Owner’s] own admissions ... leads to the unmistakable conclusion that the claims at issue were anticipated.”).

c. Element [1.3]: “transmitting a UL control channel and a UL data channel to the BS through the transmission BWP based on the BWP configuration information and the frequency hopping configuration information,”

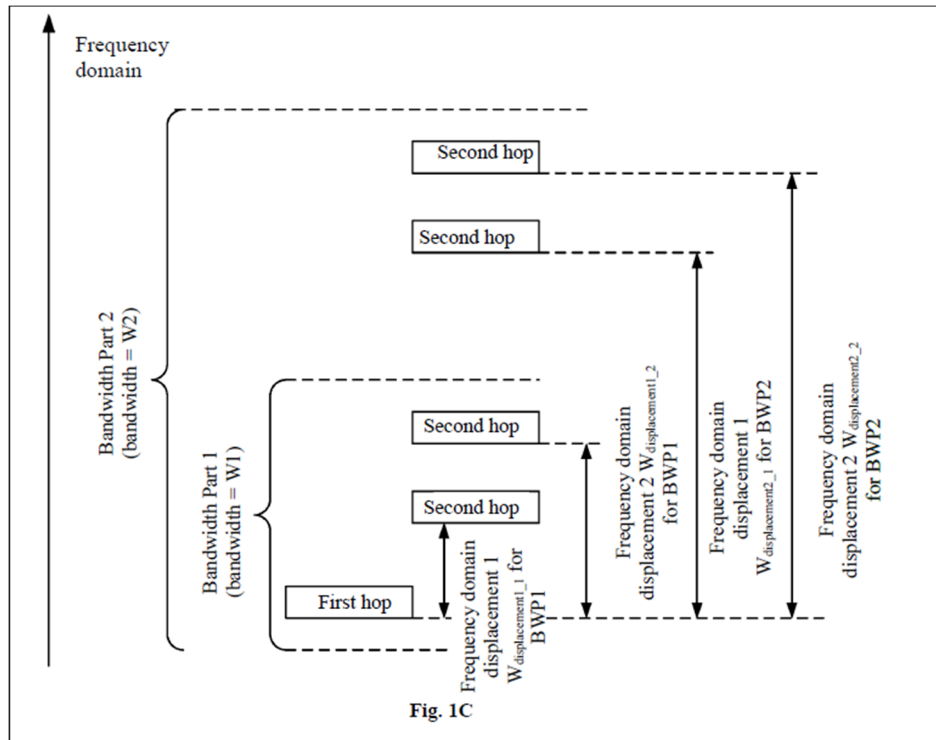
Shen anticipates or renders obvious Element [1.3]. Shen discloses transmitting physical UL control and data channels (i.e., Shen’s “PUCCH” and “PUSCH” control/data channels) to its network device (BS) through a transmission BWP designated in Shen as the “activated BWP.” EX1013, 5:26-28; 13:21-36. A POSITA would have understood that Shen’s transmission BWP (i.e., Shen’s “activated BWP”) is based on the BWP configuration information (information used to configure the BWP) and the frequency hopping configuration information (i.e., information included in the BWP, such as Shen’s “frequency domain displacement” or offset $W_{\text{displacement}}$, where W is the bandwidth of the “activated BWP”). *Id.*, 13:27-

36; Fig. 1B. Shen's terminal *transmits* "the physical channel to the network device" using the frequency hopping configuration information and the BWP configuration information. EX1013, 10:19-27. $W_{\text{displacement}}$ is frequency hopping configuration information. §VII.A.1.b. EX1031, ¶¶[0142-146].

d. Element [1.4]: "wherein the frequency hopping configuration information for a UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values, and"

Shen anticipates or renders obvious Element [1.4]. Shen's frequency hopping configuration information (*see* Element [1.2] *infra*) for its UL data channel "PUSCH" includes a frequency hopping offset set composed of one or more frequency hopping offset values. Shen states: "different frequency domain displacement sets are configured for different BWPs," and each such set constitutes a frequency hopping offset set composed of one or more frequency domain displacements (i.e., one or more frequency hopping offset values). EX1013, 5:15-18; 7:25-32. Shen's "frequency domain displacement configuration" information includes two different frequency domain offset values $W_{\text{displacement1}_1}/W_{\text{displacement1}_2}$ and $W_{\text{displacement2}_1}/W_{\text{displacement2}_2}$ configured for different BWPs. *Id.*, 8:3-7. Shen's Fig. 1C (reproduced below) illustrates "two frequency domain displacements" are configured for BWP1 ($W_{\text{displacement1}_1}/W_{\text{displacement1}_2}$) and for BWP2 ($W_{\text{displacement2}_1}/W_{\text{displacement2}_2}$). *Id.* Shen's configuration information indicates "at

least one frequency domain displacement separately configured for each of at least one BWP.” *Id.*, 8:29-31.



Thus, Shen discloses or renders obvious the claimed “frequency hopping offset set composed of one or more frequency hopping offset values”—the very feature that secured allowance of the ’460 Patent. §V.B. EX1031, ¶¶148-150.

- e. Element [1.5]: “wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant downlink control information (DCI).”**

Shen anticipates or renders obvious Element [1.5]. Shen’s frequency hopping offset value (i.e., “frequency domain displacement”, EX1013, 6:17-29) used to

transmit the UL data channel among the frequency hopping offset values $W_{\text{displacement1_1}}/W_{\text{displacement1_2}}$ and $W_{\text{displacement2_1}}/W_{\text{displacement2_2}}$ (*Id.*, 8:3-7) in the frequency hopping offset set (i.e., “frequency domain displacement set, *Id.*, 5:15-18; 8:20-26) is indicated by the network device (BS) to the terminal (UE) by UL grant downlink control information (“DCI”). Shen’s “DCI” indicates “frequency domain displacement” information (i.e., a frequency hopping offset value). *Id.*, 6:17-7:2; 10:1-7. EX1031, ¶¶152-156.

2. Claim 3: “The method of claim 1, wherein a number of frequency hopping offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the transmission BWP”

Shen anticipates or renders obvious Claim 3. Shen’s number of frequency hopping offset values ($W_{\text{displacement1_1}}/W_{\text{displacement1_2}}$) in the frequency hopping offset set (“frequency domain displacement set”) is determined based on a number of Resource Blocks (“RB”). EX1013, 5:21-25. Shen’s RBs are “physical resource blocks (PRBs)” constituting the transmission BWP because Shen’s transmission BWP is “expressed by number of RBs.” EX1031, ¶¶158-162.

3. Claim 5 (Preamble): “A method for a base station (BS) to receive an uplink (UL) control channel and a UL data channel from a user equipment (UE), the method comprising:”

Shen anticipates or renders obvious Claim 5 which recites a base station (BS) method that complements Claim 1’s UE method. §VII.A.1. Because Shen discloses

a BS/UE uplink (UL) data/control transmission, Claim 5 is anticipated or rendered obvious for similar reasons as Claim 1. EX1031, ¶¶163-166.

a. Element [5.1]: “transmitting bandwidth part (BWP) configuration information of a BWP set composed of one or more BWPs configured for a UE to the UE;”

Element [5.1] is anticipated or rendered obvious by Shen’s transmitting BWP configuration information discussed in Element [1.1] to a UE. *See* §VII.A.1.a. EX1031, ¶¶167-168; EX1013, 6:4-5: Shen transmits “configuration information” to the terminal “to indicate the configuration of the at least one BWP.”

b. Element [5.2]: “transmitting frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one reception BWP of the BWP set to the UE; and”

Element [5.2] is anticipated or rendered obvious by Shen’s transmitting frequency hopping configuration information as discussed in Element [1.2] to a UE. *See* §VII.A.1.b. EX1031, ¶¶169-170; EX1013, 5:21-23: the network device (BS) “transmits a first configuration information” indicating “at least one frequency domain displacement separately configured for each of at least one BWP.”

c. Element [5.3]: “receiving the UL control channel and the UL data channel from the UE through the reception BWP based on the BWP configuration information and the frequency hopping configuration information,”

Element [5.3] is anticipated or rendered obvious by Shen’s BS receiving the UL control and data channels discussed in Element [1.3] from the UE through the reception BWP based on the BWP configuration information and the frequency

hopping configuration information. §VII.A.1.c. Shen's network device or base station receives the physical channels transmitted by the UE. EX1013, 10:26-27; EX1031, ¶¶171-172.

- d. Element [5.4]: “wherein the frequency hopping configuration information for a UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values, and”**

Shen anticipates or renders obvious Element [5.4] for the reasons discussed in Element [1.4]. §VII.A.1.d. EX1031, ¶173.

- e. Element [5.5]: “wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant downlink control information (DCI).”**

Shen anticipates or renders obvious Element [5.5] for the reasons discussed in Element [1.5]. §VII.A.1.e. EX1031, ¶174.

- 4. Claim 7: “The method of claim 5, wherein a number of frequency hopping offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the reception BWP.”**

Shen anticipates or renders obvious Claim 7 for the reasons discussed for Claim 3. §VII.A.2; EX1031, ¶175.

5. Claim 9 (Preamble): “A user equipment (UE) for transmitting an uplink (UL) control channel and a UL data channel to a base station (BS), the UE comprising:”

Shen anticipates or renders obvious Claim 9 which is directed to “UE” that performs Claim 1’s method. Claim 9 is anticipated or rendered obvious for the reasons discussed for Claim 1. §VII.A.1. EX1031, ¶¶176-179.

a. Element [9.1]: “a receiver configured to receive, from a BS, bandwidth part (BWP) configuration information of a BWP set composed of one or more BWPs configured for the UE and receive, from the BS, frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one transmission BWP of the BWP set; and”

Element [9.1] is anticipated or rendered obvious by Shen’s “terminal” with a “receiving unit” for receiving from a “network device” (BS) the BWP configuration information and the frequency hopping configuration information discussed in Elements [1.1] and [1.2]. §§VII.A.1.a, VII.A.1.b. Shen’s “receiver” (“receiving unit”) receives from the BS “a first configuration information of a transmission physical channel” that indicates “at least one frequency domain displacement separately configured for each of at least one BWP.” EX1013, 4:2-4. EX1031, ¶¶180-183.

b. Element [9.2]: “a transmitter configured to transmit a UL control channel and a UL data channel to the BS through the transmission BWP based on the BWP configuration information and the frequency hopping configuration information,”

Element [9.2] is anticipated or rendered obvious by Shen which discloses a “terminal” (UE) with a “transmitting unit” configured to transmit the UL control channel and the UL data channel discussed in Element [1.3] to the “network device” (BS) through the transmission BWP based on the BWP configuration information and the frequency hopping configuration information as discussed in Element [1.3]. §VII.A.1.c. Shen’s “transmitter” (“a transmitting unit 43”⁷) determines “the position of the first frequency domain resource of the physical channel ... in the activated BWP” based on the bandwidth of the activated BWP and the utilized frequency domain displacement and “transmit[s] the [information of] the physical channel to the network device.” EX1013, 13:27-35. EX1031, ¶¶184-189.

Shen’s receiver and transmitter are configured to (and not merely capable of) perform the functions of Claims 1 and 9. §VI. EX1031, ¶¶180-189.

⁷ The reference to “network device” in the description of the “transmitting unit 43” in EX1013, 13:27-34 is clear error because Shen states: “Fig. 4B is a schematic diagram of the structure of another terminal ...” EX1013, 5:1-2.

- c. Element [9.3]: “wherein the frequency hopping configuration information for a UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values, and”**

Shen anticipates or renders obvious Element [9.3] for the reasons discussed in Element [1.4]. §VII.A.1.d. EX1031, ¶190.

- d. Element [9.4]: “wherein a frequency hopping offset value used to transmit the UL data channel among the frequency hopping offset values included in the frequency hopping offset set is indicated by UL grant downlink control information (DCI).”**

Shen anticipates or renders obvious Element [9.4] for the reasons discussed in Element [1.5]. §VII.A.1.e. EX1031, ¶191.

- 6. Claim 11: “The UE of claim 9, wherein a number of frequency hopping offset values included in the frequency hopping offset set is determined based on a number of physical resource blocks (PRBs) constituting the transmission BWP.”**

Shen anticipates or renders obvious Claim 11 for the reasons discussed for Claim 3. §VII.A.2. EX1031, ¶192.

- 7. Claims 1, 3, 5, 7, 9, and 11 Would Have Been Obvious Over Shen**

- a. Unpatentability of Claims 1, 3, 5, 7, 9, and 11 is Supported by POSITA Knowledge**

Shen anticipates claims 1, 3, 5, 7, 9, and 11. §VII.A.1-6. To the extent the Board determines that POSITA knowledge is necessary for the transmission of the frequency hopping configuration information through “one transmission BWP of the

BWP set” or “one reception BWP of the BWP set” (Elements [1.2], [5.2], and [9.2]), Petitioners’ expert confirms that Shen provides this disclosure. The ’460 Patent discloses that the frequency hopping configuration information is transmitted through higher layer signaling and specifically mentions RRC signaling within the context of BWP. EX1001, 15:8-10. Shen similarly discloses that its frequency hopping configuration information is transmitted from the BS to the UE using the same “high-level signaling or system broadcast message,” such as “radio resource control (RRC) signaling.” *Id.*, 5:19-37; 6:9-22. Therefore, Shen discloses that the frequency hopping configuration information is transmitted through one transmission BWP of the BWP set to the extent disclosed in the ’460 Patent. *Id.*, ¶¶194-196.

In addition, a POSITA would have recognized that Shen’s disclosed use of “high-level signaling or system broadcast message” (EX1013, 5:29-37) constitutes an express teaching and/or suggestion/motivation to transmit, through one transmission/reception BWP of the BWP set, because Shen discloses transmitting the frequency hopping configuration information through the RRC protocol messages that contain downlink control information (DCI) messages (*Id.*, 6:17-22). The RRC protocol messages, which contain the DCI used by the BS to specify UE configuration parameters, including the frequency hopping configuration, are transmitted to the UE over a downlink control channel, such as a physical downlink

control channel (PDCCH), which Shen states is one of the “physical channel[s]” configured for each BWP. *Id.*, 5:19-37. The PDCCH, as taught by Shen, is transmitted to the UE through the BWP (i.e., inside the BWP frequency range). *Id.* A POSITA would have had a reasonable expectation of success given that Shen expressly teaches and suggests this technique. EX1031, ¶197-199.

B. Claims 2, 4, 6, 8, 10, and 12 Would Have Been Obvious Over Shen in View of Matsumura and R1-1801080 (Ground 2)

1. Claims 2, 6, and 10 are Unpatentable Over Shen and Matsumura

- a. Claim 2: “The method of claim 1, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel.”**

Shen does not explicitly disclose that Shen’s “frequency hopping configuration information” (“frequency domain displacement configuration” information) includes “at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel.” However, Matsumura discloses that the frequency hopping configuration information (i.e., “frequency resource information” indicating a frequency offset

[EX1019, ¶[0066]) includes information indicating whether to perform frequency hopping and physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel. EX1019, ¶¶[0041], [0049], [0093-97].

Matsumura specifically discloses that the frequency resource information (i.e., the frequency hopping configuration information) includes information indicating whether frequency hopping is enabled (turned on or off) and an index of a PRB of a specific frequency resource (*e.g.*, a starting frequency resource of a first hop), and information related to other frequency resources (*e.g.*, frequency resources of second and subsequent hops). EX1019, ¶[0049], [0093-97]. EX1031, ¶¶202-203.

A POSITA would have been motivated to implement Matsumura's frequency hopping technique of indicating whether frequency hopping is enabled and an index of a PRB in Shen's frequency domain displacement information to improve the transmission performance of Shen's "PUCCH" control channel to exploit a larger BWP bandwidth and increase frequency selective gain. EX1013, 5:15-18, 8:20-26. EX1031, ¶204.

A POSITA would have understood Shen and Matsumura share objectives of enhanced transmission performance of the physical uplink channel by fully utilizing a larger BWP bandwidth. Such modification would have been a routine addition to Shen's frequency hopping domain displacement which is expressed as RBs, which

a POSITA would understand to be PRBs. EX1013, 5:24-25. EX1031, ¶¶205-206. Enhancing Shen's frequency hopping domain offset using Matsumura's indication of whether frequency hopping is enabled and PRB allocation information would have been an obvious way to improve the transmission performance of the physical uplink channel in exactly the manner contemplated by Shen. EX1013, Abstract, 4:7-13; 5:15-18; 8:20-26; 11:4-11. Such a modification would have been routine, and according to known methods, to obtain predictable results with a reasonable expectation of success. EX1031, ¶¶207-208.

b. Claim 6: “The method of claim 5, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel.”

Claim 6 recites the same limitations as Claim 2 from the perspective of the BS. Shen in view of Matsumura teaches the substantive limitations of Claim 6 for the reasons discussed for Claim 2. §VII.B.1.a. EX1031, ¶¶209-210.

- c. **Claim 10: “The UE of claim 9, wherein the frequency hopping configuration information for a UL control channel includes at least one of information indicating whether to perform frequency hopping, physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel.”**

Claim 10 recites the same limitations as Claim 2 from the perspective of the UE apparatus. Shen in view of Matsumura teaches the substantive limitations of Claim 10 for the reasons discussed for Claim 2. §VII.B.1.a. EX1031, ¶¶211-212.

2. Claims 4, 8, and 12 are Unpatentable Over Shen, Matsumura, and R1-1801080

- a. **Claim 4: “The method of claim 3, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less.”**

Shen does not explicitly disclose the Claim 4 limitation that Shen’s “frequency hopping offset values included in the frequency hopping offset set” are determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less. However, Matsumura discloses Claim 4. EX1031, ¶¶213-214.

Matsumura expressly discloses a preset threshold value for the number of PRBs constituting the transmission BWP, and uses this threshold value to determine the frequency hopping offset values. Matsumura describes that frequency resources may be indicated in the DCI by an X-bit resource allocation field (Fig. 14A)

including Y-bits (e.g., a number of PRBs Y) indicating whether frequency hopping is enabled and Z-bits indicating frequency hopping resources (e.g., for the second and subsequent hops) and frequency offset values (“ $1/2 \cdot S$ ”, “ $+1/4 \cdot S$ ”, and “ $-1/4 \cdot S$ ”, Fig. 14C). EX1019, ¶¶[0114-121]. The number of Z-bits may be based on the bandwidth S of the access bandwidth of the user terminal (e.g., UL BWP). *Id.*, ¶[0119]. When the access BWP (represented as a number of PRBs, *Id.*, ¶[0106]) is less than or equal to a predetermined threshold, frequency hopping is not enabled. *Id.*, ¶[0119]. Therefore, Matsumura discloses using a preset threshold value for the number of PRBs constituting the transmission BWP to determine the frequency hopping offset values. EX1031, ¶215.

A POSITA would have been motivated to combine Matsumura’s threshold within Shen’s method to control when frequency hopping is enabled to maximize frequency hopping without exceeding the BWP bandwidth. EX1013, 5:15-18, 8:20-26. EX1031, ¶216.

A POSITA would have understood Matsumura’s techniques of disabling frequency hopping when the number of PRBs constituting the transmission BWP is smaller than a predetermined threshold to be consistent with Shen’s objectives of fully utilizing a larger BWP bandwidth to obtain a greater frequency selective gain. Matsumura’s addition of a predetermined threshold would have been a routine addition to Shen’s frequency domain offset expressed by the number of RBs.

Enhancing Shen's number of PRBs by utilizing Matsumura's threshold would have been an obvious way to improve the transmission performance of the physical uplink channel in exactly the manner contemplated by Shen. Such a modification would have been routine, and according to known methods, to obtain predictable results with a high probability of success. EX1031, ¶¶217-220.

R1-1801080 also discloses Claims 4, 8, and 12. EX1031, ¶192. R1-1801080 refers to the size of the BWP in terms of number of Physical Resource Blocks ("PRBs"):

When frequency hopping on PUSCH is enabled and for resource allocation type 1, frequency offsets are configured by higher layer parameter Frequency-hopping-offsets-set:

- ***when the size of the active BWP is less than [50] PRBs***, one of two higher layer configured offsets is indicated in the UL grant ...

EX1017, §2.3, p.2/33. Notably, the '460 Patent discloses the same values. EX1001, 13:5-21. EX1031, ¶¶221-222.

A POSITA would have been motivated to combine Shen, Matsumura, and R1-1801080 to improve the transmission performance of the physical uplink channels in 5G communication systems. EX1013, 4:7-13; EX1019, ¶¶[0275-276]; EX1017, §2.3, p.2/33. EX1031, ¶223.

A POSITA would have understood R1-1801080's proposal confirming the value 50 as the boundary number of PRBs in the active UL BWP between

bandwidths having two or four frequency offsets to be consistent with Shen's and Matsumura's objectives of fully utilizing a larger BWP bandwidth to obtain a greater frequency selective gain. R1-1801080's addition of the value 50 as the boundary number of PRBs in the active UL BWP would have been a routine addition to Matsumura's predetermined threshold. Enhancing Matsumura's threshold with the specific value 50 would have been an obvious way to improve the transmission performance of the physical uplink channel in exactly the manner contemplated by Shen and Matsumura. Such a modification would have been routine, and according to known methods, to obtain predictable results with a high probability of success. EX1031, ¶¶224-226.

b. Claim 8: “The method of claim 7, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the reception BWP is a preset threshold value or less.”

Claim 8 recites the same limitations as Claim 4 from the perspective of the BS and the “reception BWP” of the BS, as opposed to the “transmission BWP” of the UE. Shen, Matsumura, and R1-1801080 teach or render obvious Claim 8 for the reasons discussed for Claim 4. §VII.B.2.a. EX1031, ¶¶227-229.

- c. Claim 12: “The UE of claim 11, wherein the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less.”**

Claim 12 recites the same limitations as Claim 4 from the perspective of the UE apparatus. Shen, Matsumura, and R1-1801080 teach or render obvious Claim 12 for the reasons discussed for Claim 4. §VII.B.2.a. EX1031, ¶¶230-232.

C. Claims 1-12 Are Anticipated by Zhang or Obvious Over Zhang in View of Matsumura and R1-1801080 (Ground 3)

Zhang is a detailed document that anticipates or renders obvious Claims 1-12. §VII.C.6.

1. Claim 1 (Preamble)

Zhang anticipates or renders obvious the Preamble. Zhang’s UE transmits an uplink (UL) control channel (i.e., Zhang’s PUCCH) and a UL data channel (i.e., Zhang’s PUSCH) to a BS. EX1020, Abstract, ¶¶[0020-22], [0550], [0572]; Fig. 5. EX1031, ¶234. Both the ’460 Patent and POSITA recognize PUCCH as “uplink control channel” and PUSCH as a “UL data channel.” EX1001, 4:28-34. EX1031, ¶¶118, 235.

a. Element [1.1]

Zhang anticipates or renders obvious Element [1.1]. Zhang discloses receiving from the BS a BWP configuration information (“BWP resource indication information”) of a BWP set (BWP resources within the whole bandwidth) composed

of one or more BWPs (intra-BWP PRB resources) configured for the UE. EX1020, ¶¶[0010-12]; [0020-21]. The BWP resource indication information indicates the BWP resources allocated by the BS to the UE, and the intra-BWP PRB resource indication information indicates the intra-BWP PRB resources allocated by the BS to the UE. *Id.*, ¶¶[0011-12], [0056]; EX1031, ¶¶236-238.

b. Element [1.2]

Zhang anticipates or renders obvious Element [1.2]. The '460 Patent discloses that the frequency hopping configuration information for a UL control channel may include at least one of information indicating whether to perform frequency hopping, PRB allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel. EX1001, 12:33-39.

Zhang discloses receiving, from the BS, frequency hopping configuration information, such as uplink resource allocation, which indicates information of Physical Resource Blocks ("PRBs") within the BWP and includes frequency hopping resource allocation. EX1020, ¶[0224]. Zhang's UL control/data channels (PUCCH/PUSCH) are transmitted through one transmission BWP ("BWP resource") of the BWP set. EX1020, ¶¶[0010-12]; [0020-21]. Zhang's resource allocation supports two frequency hopping indications, i.e., no frequency hopping and frequency hopping, and three PRB allocation ways, i.e., continuous allocation

of PRBs, discontinuous allocation of PRBs and partially continuous allocation of PRBs. *Id.*, ¶[0224]. Zhang explicitly discloses that the frequency hopping indication information is located in the at least one of the BWP indication information and the intra-BWP PRB resource indication information. *Id.* ¶[0231]. EX1031, ¶¶239-242. Thus, Zhang discloses that the frequency hopping configuration information is transmitted through one transmission BWP of the BWP set.

c. Element [1.3]

Zhang anticipates or renders obvious Element [1.3]. Zhang's transmitting, by the UE, of UL data on a PUSCH and UL control information on a PUCCH is based on BWP configuration information (the BWP resource indication information) and frequency hopping configuration information (the intra-BWP PRB resource indication information allocated to the UE by the BS). §VII.C.1.a-b. When Zhang's "UL grant" information contains the frequency hopping indication information, the UE determines the PRB resources used for UL transmission allocated within the uplink BWP based on the intra-BWP inter-PRB frequency hopping resource allocation information (i.e., frequency hopping configuration information) in the intra-BWP PRB resource indication information. EX1020, ¶[0295]. EX1031, ¶¶243-244.

d. Element [1.4]

Zhang anticipates or renders obvious Element [1.4]. Zhang's frequency hopping configuration information (the intra-BWP PRB resource indication information allocated to the UE by the BS) for a UL data channel includes a frequency hopping offset set, such as an intra-BWP PRB resource block group ("RBG") offset indication for different BWPs, composed of one or more frequency hopping offset values. EX1020, ¶[0460]. Zhang discloses that the intra-BWP PRB resources are allocated inside the BWP resource by the BS ("the intra-BWP PRB resource indication information **indicates the BWP resources within the BWP** which is allocated by the base station to the UE ..."). *Id.*, ¶[0262]. EX1031, ¶245-247.

Zhang's UE can obtain a starting PRB location ("RBSTART") and the number ("LCRBs") of allocated continuous PRBs according to the Resource Indication Value ("RIV"). EX1020, ¶[0172]. If the frequency hopping flag is 1 (*e.g.*, frequency hopping is active or enabled), the resource allocation indication includes both the frequency hopping resource allocation information and the RIV. *Id.* The BS allocates one or more RBG resources, each including a fixed number of PRBs, within an RBG set to the UE. *Id.*, ¶¶[0453], [0458]. The BS first indicates the RBG set resource allocation information, and then generates a corresponding bit set according to whether to allocate a certain RBG within the RBG set. *Id.*, ¶[0460].

Both the RBG set resource allocation information and the generated corresponding bit set are included in the intra-BWP PRB resource allocation information transmitted to the UE in the UL grant. *Id.* EX1031, ¶¶248-252.

Zhang specifies the PRBs that are allocated to either a BWP and an intra-BWP so that these PRBs can be allocated on a continuous or discrete basis using a bit map where each bit's position has a one-to-one relationship with a specific PRB.

After receiving the intra-BWP PRB resource allocation information in the UL Grant, the UE acquires the RBG set resource allocation information according to the RBG set index information therein, and **allocates the location with the value 1 in the bit-map information according to the PRB resources**, acquires one or more PRB resource information allocated within the RBG set. If multiple PRB resources are allocated, the **different PRBs can be continuous or discrete**.

Id., ¶[0471].

Using this bit map allocation method, Zhang's intra-BWP PRB resource allocation information includes a fixed bit of RBG offset indication for different BWPs. *Id.*, ¶[0460]. Thus, Zhang discloses using different BWPs where a frequency hopping offset, from a set of offsets, can be specified for a specific BWP. EX1031, ¶¶253-254.

e. Element [1.5]

Zhang anticipates or renders obvious Element [1.5]. Zhang's frequency hopping offset value used to transmit the UL data channel among the frequency

hopping offset values included in the frequency hopping offset set is indicated by the BS to the UE using Downlink Control Information (“DCI”), which includes the frequency hopping offset value. EX1020, ¶¶[0166-172], [0326-330]. EX1031, ¶255.

2. Claim 2

Zhang anticipates or renders obvious Claim 2. Zhang’s frequency hopping configuration information includes information indicating whether to perform frequency hopping (“no frequency hopping and frequency hopping” or whether frequency hopping is enabled), physical resource block (PRB) allocation information of a first frequency resource region of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel, such as continuous allocation of PRBs, discontinuous allocation of PRBs, and partially continuous allocation of PRBs. EX1020, ¶[0224]. EX1031, ¶256.

3. Claim 3

Zhang anticipates or renders obvious Claim 3. Zhang’s number of frequency hopping offset values (the intra-BWP PRB resources) included in the frequency hopping offset set is determined based on the number of physical resource blocks (PRBs) designated as the number of segments of multiple continuous RBG resources constituting the transmission BWP allocated by the BS to the UE. EX1020, ¶¶[0262-269], [0320]. EX1031, ¶257.

4. Claim 4

Zhang anticipates or renders obvious Claim 4. Zhang's number of frequency hopping offset values (the intra-BWP PRB resources) included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less. Zhang specifically discloses that the size of the BWP bandwidth, where the uplink resources allocated by the BS to the UE are located, consists of a fixed number P of PRBs (the number of PRBs in the RBG at the edge of the BWP may be less than P), wherein P is a positive integer. EX1020, ¶[0453]. EX1031, ¶¶258-259.

5. Claims 5-8 and 9-12

Claims 5-8 recite the same elements as Claims 1-4 from the BS perspective. EX1001, 19:51-20:9. Zhang renders these claims unpatentable because Zhang discloses a BS/UE uplink data and control transmission. EX1020, Abstract, ¶¶[0020-22], [0136], [0509], [0572]. Claims 9-12 are UE claims that recite structural elements (i.e., communication interface 310 for transmitting/receiving a signal) that perform the functions of Claims 1-4. EX1001, 19:51-20:9. Zhang teaches or renders obvious Claims 5-8 and 9-12 for the reasons discussed for Claims 1-4. §VII.C.1-4. EX1031, ¶¶260-263.

6. Claims 1-12 Would Have Been Obvious Over Zhang in View of Matsumura and R1-1801080

a. Claims 1-3, 5-7, and 9-11 are Unpatentable Over Zhang and Matsumura

Zhang anticipates or renders obvious claims 1-3, 5-7, and 9-11. *See* §VII.C *infra*.

To the extent clarification is warranted of Zhang's disclosure of "a frequency hopping offset set composed of one or more frequency hopping offset values" (Elements [1.4], [5.4], [9.4]), Matsumura expressly discloses this feature. EX1019, ¶¶[0050], [0066]. EX1031, ¶238. Matsumura discloses in Figs. 7A and 7B multiple frequency offset values k2, k3, k4 notified from the BS to the UE. *Id.*, ¶[0060]. EX1031, ¶¶264-269.

A POSITA would have been motivated to combine Matsumura's frequency offset values k2, k3, k4 with Zhang's method to efficiently allocate UE resources and appropriately control the uplink channel frequency hopping in 5G communication systems. EX1020, ¶¶[0056], [0109], [0224-225]; EX1019, ¶¶[0008-0011]. Such a modification would have been routine, and according to known methods, to obtain predictable results with a high probability of success. EX1031, ¶¶270-271.

b. Claims 4, 8, and 12 are Unpatentable Over Zhang, Matsumura, and R1-1801080

Claims 4, 8, and 12 recite that “the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission [or reception] BWP is a preset threshold value or less.” Zhang discloses this feature. §VII.C.4.

To the extent clarification is warranted of Zhang’s disclosure that “the number of PRBs constituting the transmission BWP is a preset threshold value or less,” Matsumura also discloses this feature. §VII.B.2. EX1031, ¶243. Similarly, R1-1801080 discloses that “*when the size of the active BWP is less than [50] PRBs*, one of two higher layer configured offsets is indicated in the UL grant.” §VII.B.2. EX1031, ¶¶272-274.

A POSITA would have been motivated to combine Zhang, Matsumura, and R1-1801080 to improve the transmission performance of the physical uplink channel and the accuracy in UE resource allocation in 5G communication systems. EX1020, ¶¶[0163-169], [0174-175], [0488-490]; [0521-522]; EX1019, ¶¶[0275-276]; EX1017, §2.3, p.2/33; EX1031, ¶274.

Similar to R1-1801080, Zhang’s and Matsumura’s systems define the size of the BWP as a concept of Resource Blocks (“RB”) or resource block group (“RBG”), in which each RBG consists of a fixed number P of PRBs, wherein P is a positive integer. EX1020, ¶[0457]; EX1019, ¶[0098]. The BS allocates the uplink

transmission resources in units of PRBs. EX1020, ¶[0458]. Matsumura explicitly discloses that, when the number of PRBs constituting the transmission BWP is smaller than a predetermined threshold, frequency hopping is not enabled. EX1019, ¶[0078].

A POSITA would have understood R1-1801080's proposal confirming the value 50 as the boundary number of PRBs in the active UL BWP between bandwidths having two or four frequency offsets for frequency hopping on PUSCH to be consistent with the objectives of enhanced UE resource allocation accuracy disclosed in Zhang and Matsumura. R1-1801080's addition of the value 50 as the boundary number of PRBs in the active UL BWP would have been a routine addition to the fixed number of PRBs in the RBG at the edge of the BWP of Zhang and Matsumura's predetermined threshold. Enhancing Matsumura's threshold with the specific value 50 as the boundary number of PRBs in the active UL BWP would have been an obvious way to improve the accuracy of the UE resource allocation in exactly the manner contemplated by Zhang and Matsumura. Such a modification would have been routine, and according to known methods, to obtain predictable results with a high probability of success. EX1031, ¶¶275-280.

D. Claims 1-12 Would Have Been Obvious Over Yin in View of TS 36.211 and TS 36.213, Optionally in Further View of Jersenius (Ground 4)

Yin discloses Claim 1, with the exception of a UL data channel (PUSCH), in which the frequency hopping configuration information is configured. Because Yin does not disclose a PUSCH, Yin does not disclose PUSCH frequency hopping: i.e., a frequency hopping offset set composed of one or more frequency hopping offset values configured for the PUSCH or that the frequency hopping offset value is indicated by the UL grant DCI. However, TS 36.211 and TS 36.213 describe these features. It would have been obvious to combine Yin with TS 36.211 and TS 36.213 to arrive at the frequency hopping configuration for the PUSCH, and a POSITA would have had a reasonable expectation of success. EX1031, ¶¶281-282.

1. Claim 1 (Preamble)

Yin discloses the Preamble. Yin discloses a method for a UE 102 (Fig. 1) to transmit an uplink control information (UCI), such as Yin's Physical Uplink Control Channel ("PUCCH"), and a UL data channel, such as Yin's Physical Uplink Shared Channel ("PUSCH") to a BS, represented as gNB 160 (Fig. 1). EX1021, ¶¶[0053], [0058], [0063]; EX1022, ¶¶[0045], [0050], [0056]. EX1031, ¶284.

a. Element [1.1]

Yin discloses receiving, from a BS, bandwidth part (BWP) configuration information of a BWP set composed of one or more BWPs, such as separate PUCCH regions or subbands (*e.g.*, bandwidth parts or BWPs), configured for the UE 102.

EX1021, ¶¶[0052], [0054], [0085]; EX1022, ¶¶[0044], [0046], [0077]. Yin describes that, in order for Fifth generation (5G) cellular communications services to use the time/frequency/space medium efficiently, *multiple short PUCCH formats may be defined, and the PUCCH format of a UE may be configured by a BS*. EX1021, ¶¶[0053-55]; EX1022, ¶¶[0045-47].

Yin discloses that “separate PUCCH regions or subbands should be configured for the UE 102, and the PUCCH can be transmitted simultaneously in both regions/subbands.” EX1021, ¶[0085]; EX1022, ¶[0077]. EX1031, ¶¶285-290.

Yin discloses reference symbols (RS) patterns, *RS location and configurations for a short PUCCH* and allocating resources (e.g., “different frequency bands with different channel characteristics”) based on type of devices, which essentially describes the concept of BWPs. EX1021, ¶¶[0113-117]; EX1022, ¶¶[0109]. EX1031, ¶291.

b. Element [1.2]

Yin discloses receiving, from the BS, frequency hopping configuration information, such as a discrete Fourier transform spread OFDM (DFT-S-OFDM) waveform or a CP-OFDM waveform with a formats consisting of a number of resource blocks (RBs) and/or one or more control resource regions for a UL control channel (PUCCH). EX1021, ¶¶[0042], [0085], [0213]; EX1022, ¶¶[0034], [0104], [0199]. Yin’s UL control channel (PUCCH) is transmitted through one transmission

BWP (PUCCH region or subband) of the BWP set. EX1021, ¶[0039]; EX1022, ¶[0202]; Fig. 25. EX1031, ¶292.

Yin discloses receiving, from the BS, frequency hopping configuration information for a UL control channel, but does not explicitly disclose configuring frequency hopping for the UL data channel (PUSCH). EX1021, ¶[0112]; EX1022, ¶[0097]. However, TS 36.211 and TS 36.213 describe a BS configuring frequency hopping for the PUSCH. EX1024, §5.3.4, p.22; EX1025, §8.4, pp.114-115. EX1031, ¶292-295.

It would have been obvious for a POSITA to turn to TS 36.211 and TS 36.213 for more information on configuring frequency hopping for PUSCH uplink resources. A POSITA would have been motivated to combine the PUSCH frequency hopping configuration methods described in these specifications with the PUCCH frequency hopping disclosed in Yin because 5G NR was implemented prior to the priority date of the '460 Patent while 4G LTE remained in use, and therefore a POSITA would have recognized benefits for 5G-capable UEs to continue to connect with 4G LTE BSs. In fact, Yin explicitly states that “[a]t least some aspects of the systems and methods disclosed herein may be described in relation to the 3GPP LTE, LTE-Advanced (LTE-A) and other standards (*e.g.*, 3GPP Releases 8, 9, 10, 11 and/or 12).” EX1021, ¶[0048]; EX1022, ¶[0040]. Enhancing Yin’s PUCCH frequency hopping with the PUSCH frequency hopping configuration methods

described in TS 36.211 and TS 36.213 would have been an obvious way to improve the flexibility and/or efficiency of the UE resource allocation in exactly the manner contemplated by Yin. EX1021, ¶¶[0004-0005], [0053-55]; EX1022, ¶¶[0003-0004], [0045-47]. This integration allows 5G NR-only capabilities (e.g., BWPs) to be implemented when possible, while retaining backwards-compatible methods for 4G LTE. Such a modification would have been routine, and according to known methods, to obtain predictable results with a high probability of success. EX1031, ¶¶296-301.

c. Element [1.3]

Yin discloses transmitting a UL control channel, represented by Yin's UL control information (UCI), to the BS, through the transmission BWP (i.e., "PUCCH resource corresponding to the PUCCH resource configuration within the selected set of PUCCH resource configurations") based on the BWP configuration information (i.e., PUCCH regions or subbands, *e.g.*, bandwidth parts or BWPs), configured for the UE 102, and the frequency hopping configuration information, such as a discrete Fourier transform spread OFDM (DFT-S-OFDM) waveform or a CP-OFDM waveform with a formats consisting of a number of resource blocks (RBs) and/or one or more control resource regions. EX1021, ¶¶[0038-39], [0095], [0216]; EX1022, ¶¶[0057], [0087], [0202]; Fig. 25. EX1031, ¶302.

Yin does not explicitly disclose transmitting a UL data channel (*e.g.*, PUSCH) based on the BWP configuration information and the frequency hopping configuration information. However, TS 36.211 and TS 36.213 describe a UE transmitting the PUSCH. EX1024, §5.3.4, p.22; EX1025, §8.4, pp.114-115. EX1031, ¶¶302-303.

A POSITA would have been motivated to combine the PUSCH transmission methods described in TS 36.211 and TS 36.213 with the PUCCH transmission methods disclosed in Yin as an obvious way to improve the flexibility and/or efficiency of the UE resource allocation in exactly the manner contemplated by Yin. §VII.D.1.c; EX1021, ¶¶[0004-0005], [0053-55]; EX1022, ¶¶[0003-0004], [0045-47]. Such a modification would have been routine, and according to known methods, to obtain predictable results with a high probability of success. EX1031, ¶¶305-306.

d. Element [1.4]

Yin discloses that the UE receives from the BS frequency hopping configuration information. §VII.D.1.b.

Yin does not explicitly disclose that the frequency hopping configuration information for a UL data channel (*e.g.*, PUSCH) includes a frequency hopping offset set composed of one or more frequency hopping offset values. However, TS 36.213 describes PUSCH frequency hopping and multiple hopping types (set of offsets). A UE performing PUSCH frequency hopping uses one of two PUSCH

frequency hopping types--PUSCH hopping type 1 (§8.4.1) and type 2 (§8.4.2)--based on the hopping information. EX1025, pp.114-115.

8.4.2 Type 2 PUSCH hopping

In PUSCH hopping type 2 the set of physical resource blocks to be used for transmission in slot n_s is given by the scheduling grant together with a predefined pattern according to [3] subclause 5.3.4. If the system frame number is not acquired by the UE yet, the UE shall not transmit PUSCH with type-2 hopping and $N_{sb} > 1$ for TDD, where N_{sb} is defined in [3].

Table 8.4-2: PDCCH/EPDCCH DCI format 0 hopping bit definition

System BW N_{RB}^{UL}	Number of Hopping bits	Information in hopping bits	$\tilde{n}_{PRB}(i)$
6 – 49	1	0	$\left(\left\lfloor N_{RB}^{PUSCH} / 2 \right\rfloor + \tilde{n}_{PRB}^{S1}(i) \right) \bmod N_{RB}^{PUSCH}$,
		1	Type 2 PUSCH Hopping
50 – 110	2	00	$\left(\left\lfloor N_{RB}^{PUSCH} / 4 \right\rfloor + \tilde{n}_{PRB}^{S1}(i) \right) \bmod N_{RB}^{PUSCH}$
		01	$\left(- \left\lfloor N_{RB}^{PUSCH} / 4 \right\rfloor + \tilde{n}_{PRB}^{S1}(i) \right) \bmod N_{RB}^{PUSCH}$
		10	$\left(\left\lfloor N_{RB}^{PUSCH} / 2 \right\rfloor + \tilde{n}_{PRB}^{S1}(i) \right) \bmod N_{RB}^{PUSCH}$
		11	Type 2 PUSCH Hopping

EX1031, ¶¶307-309.

If the system bandwidth (BW) shown in Table 8.4.2 is between 50-110 uplink resource blocks, based on the number of system BW blocks, the UE uses at least one of three different frequency hopping offset values “00”, “01”, “10” for frequency hopping as specified by the BS within a set of hopping bit values, as shown by the different formulas and calculations for each hopping offset value “00”, “01”, “10” in Table 8.4.2. *Id.* For example, if the system BW is 50 RBs (the lower category for System BW of 50-110 in Table 8.4-2), the UE will calculate a first hopping offset value of 22 PRBs to use when the “information in hopping bits” is set to “10” by the BS. EX1025, §8.4.1, ll.1-5, p.115; EX1031, ¶¶310-312.

TS 36.213 describes a DCI format 0 (DCI 0) message that is transmitted from the BS and is used by the UE to configure PUSCH frequency hopping. EX1025, §8.4, p.114. EX1031, ¶313.

The RRC signaling protocol message in DCI 0 that is sent from the BS to the UE indicates multiple hopping parameters: (1) PUSCH frequency hopping is to be performed; and (2) for Type 1 frequency hopping, the frequency offset to be used for the first hop from a set of three different hops. EX1025, §8.4, p.114; *see also* Examples in EX1031, ¶¶309-314.

A POSITA would have had reason to combine TS 36.213's PUSCH frequency hopping offset set composed of multiple frequency hopping offset values within Yin's PUCCH frequency hopping offset set composed of one or more frequency hopping offset values as an obvious way to improve the flexibility and/or efficiency of the UE resource allocation in exactly the manner contemplated by Yin. §VII.D.1.c; EX1021, ¶¶[0004-0005], [0053-55]; EX1022, ¶¶[0003-0004], [0045-47]. Such a modification would have been routine, and according to known methods, to obtain predictable results with a high probability of success. EX1031, ¶¶315-316.

e. Element [1.5]

Yin discloses that a short PUCCH format and/or resource for the UE can be dynamically indicated by physical layer signaling (*e.g.*, a DCI). EX1021, ¶[0124]; EX1022, ¶[0116]. Yin does not explicitly disclose that a frequency hopping offset

value used to transmit the UL data channel is indicated by the UL grant DCI. However, TS 36.213 explicitly describes that a UL grant DCI message is used for the PUSCH (*e.g.*, uplink data channel) frequency hopping offset. EX1025, p.115; EX1031, ¶¶317-319.

A POSITA would have had reason to combine TS 36.213's PUSCH UL grant DCI message with Yin's PUCCH UL grant DCI message as an obvious way to improve the flexibility and/or efficiency of the UE resource allocation in exactly the manner contemplated by Yin. §VII.D.1.c; EX1021, ¶¶[0004-0005], [0053-55]; EX1021, ¶¶[0003-0004], [0045-47]. Such a modification would have been routine, and according to known methods, to obtain predictable results with a high probability of success. EX1031, ¶¶320-321.

2. Claim 2

Yin discloses Claim 2. Yin discloses that the frequency hopping configuration information (*i.e.*, discrete Fourier transform spread OFDM (DFT-S-OFDM) waveform or a CP-OFDM waveform), for Yin's UL control channel (PUCCH) includes information indicating physical resource block (PRB) allocation, such as a number of resource blocks (RBs) of a frequency resource region (control resource region) of the UL control channel (for a given PUCCH format. EX1021, ¶[0115]; EX1022, ¶[0107]. For example, for UEs with good signal condition, fewer RB resources may be allocated for a PUCCH. *Id.* For UEs with bad signal conditions

(e.g., cell edge UEs), more RB resources may be allocated for a PUCCH. *Id.* EX1031, ¶¶322-324.

3. Claim 3

Yin discloses Claim 3. Yin's number of frequency hopping offset values included in the frequency hopping offset set (i.e., discrete Fourier transform spread OFDM (DFT-S-OFDM) waveform or a CP-OFDM waveform) is determined based on a number of physical resource blocks (PRBs), such as multiple pairs of uplink resource blocks, constituting the transmission BWP, such as an uplink radio frame, defined by a predetermined bandwidth (RB bandwidth). EX1021, ¶¶ [0167-168]; EX1022, ¶¶[0159-160]. Yin discloses that a 2-symbol short PUCCH may employ a discrete Fourier transform spread OFDM (DFT-S-OFDM) waveform or a CP-OFDM waveform with a formats consisting of a number of RBs, an RS location and/or pattern, and/or one or more control resource regions. EX1021, ¶¶[0042], [0213]; EX1022, ¶¶[0034], [0199]. EX1031, ¶¶325-329.

Yin does not explicitly disclose that the PUSCH frequency hopping offset includes a frequency hopping offset set determined based on the number of RBs. However, TS 36.211 describes that the PUSCH frequency hopping offset is expressed in the number of RBs. EX1024, p.8. EX1031, ¶¶330-331.

A POSITA would have been motivated to combine TS 36.211's PUSCH offset expressed in the number of RBs with Yin's PUCCH offset determined based

on the number of RBs as an obvious way to improve the flexibility and/or efficiency of the UE resource allocation in exactly the manner contemplated by Yin. §VII.D.1.c; EX1021, ¶¶[0004-0005], [0053-55]; EX1022, ¶¶[0003-0004], [0045-47]. Such a modification would have been routine, and according to known methods, to obtain predictable results with a high probability of success. EX1031, ¶¶332-333.

4. Claim 4

Yin does not explicitly disclose that the number of frequency hopping offset values included in the frequency hopping offset set is determined depending on whether the number of PRBs constituting the transmission BWP is a preset threshold value or less. EX1031, ¶333.

TS 36.213 discloses in Table 8.4-2 such preset value for the number of PRBs within the transmission BWP. EX1025, §8.4.2, p.114; §VII.D.1.d. Table 8.4-2 illustrates two system bandwidth categories (*e.g.*, transmission BWP) including between 6-49 (*e.g.*, less than 50 RBs) and between 50-110 uplink resource blocks (RBs). Notably, the '460 Patent discloses the same value for the number of PRBs as the first system bandwidth in Table 8.4-2. EX1001, 13:5-21. EX1031, ¶¶334-337.

5. Claims 5-8 and 9-12

Claims 5-8 recite the same elements as Claims 1-4 from the perspective of the BS. EX1001, 19:51-20:9. Claims 9-12 are UE claims that recite the same elements as Claims 1-4. EX1001, 19:51-20:9. Yin renders these claims unpatentable because

Yin discloses a BS/UE uplink data and control transmission. EX1021, ¶¶[0053], [0058], [0063]; EX1022, ¶¶[0045], [0050], [0056]. Yin, TS 36.211, and TS 36.213 teach or render obvious Claims 5-8 and 9-12 for the reasons discussed for Claims 1-4. §VII.D.1-4. EX1031, ¶¶338-341.

6. Claims 4, 8, and 12 Would Have Been Obvious Over Yin, TS 36.211 and TS 36.213, in Further View of Jersenius

Claims 4, 8, and 12 would have been obvious over Yin, TS 36.211, and TS 36.213. §VII.D. To the extent clarification is warranted of TS 36.213's disclosure that "the number of PRBs constituting the transmission BWP is a preset threshold value or less," Jersenius expressly discloses a PUSCH bandwidth less than 50 PRBs. EX1023, ¶[0047] ("The frequency hopping value is set to BW/2 when the available bandwidth is less than 50 PRBs.") EX1031, ¶¶342-345.

A POSITA would have been motivated to combine Yin and Jersenius to improve the transmission performance and flexibility of the physical uplink channel in 5G communication systems. EX1021, ¶¶[0003-0005], [0053], [0087], [0115]; EX1023, ¶¶[0015], [0040].

Similar to Jersenius, Yin's system defines the subband size in terms of RBs. EX1021, ¶¶[0095], [0183]; EX1023, ¶[0051]. The BS allocates the uplink transmission resources in units of PRBs. *Id.* Yin discloses that UL control channels may be mapped on resource elements (REs) within multiple PRBs (*e.g.*, every 5 or 10 PRBs) within a system bandwidth. EX1021, ¶[0183]. EX1031, ¶¶346-348.

A POSITA would have understood Jersenius' value 50 as the boundary number of PRBs in an available PUSCH bandwidth configured with intra-subframe hopping to be consistent with the objectives of Yin's enhanced UE resource allocation. Jersenius' addition of the value 50 as the boundary number of the PRBs in the available PUSCH bandwidth would have been a routine addition to Yin's number of N PRBs (*e.g.*, 5 or 10) within Yin's system bandwidth. Enhancing Yin's number of PRBs with the specific value 50 as the boundary number of PRBs in the available PUSCH bandwidth would have been an obvious way to improve the accuracy of the UE resource allocation in exactly the manner contemplated by Yin. Such a modification would have been routine, and according to known methods, to obtain predictable results with a reasonable expectation of success. EX1031, ¶¶349-352.

VIII. OTHER CONSIDERATIONS

A. Secondary Considerations

Petitioners are not aware of any secondary considerations evidence bearing any nexus to the purported claimed invention. Any purported evidence of secondary considerations that Patent Owner may present in this proceeding would be insufficient to overcome the strong evidence of obviousness of the Challenged Claims. EX1031, ¶¶325-326.

B. Discretion to Institute

1. The Board Should Not Deny This Petition Under §314(a)

The '460 Patent has not been challenged in any prior AIA trial proceeding, and this Petition is not a “follow-on” petition. Events in Related Litigations do not warrant denial, and application of the *Fintiv* factors weighs against discretionary denial as explained below.

a. Factor 1: Whether the court granted a stay or evidence exists that one may be granted if a proceeding is instituted

Factor 1 weighs against discretionary denial. In the district court litigation, third party defendant and Patent Owner KT Corporation (“KT”) has disputed jurisdiction. The parties are engaged in jurisdictional discovery, and the Court has granted KT a protective order from non-jurisdictional discovery during the jurisdictional discovery period. EX1029, EX1011. This could extend the district court trial date, which “allays concerns about inefficiency and duplication of efforts” in the PTAB. *Fintiv* at 8.

b. Factor 2: Proximity of the court’s trial date to the Panel’s projected statutory deadline for a final written decision

Factor 2 should be considered at least neutral because jury selection is far in the future and is not set to begin until at least September 8, 2025. Even if jury selection were to proceed on September 8, 2025, jury selection would proceed with respect to only one of the three cases (*e.g.*, the '638 Litigation, the '639 Litigation,

or the '640 Litigation). Each of the defendant Petitioners are entitled to separate trials, which will necessarily proceed on separate dates. As such, there are explicit and inherent uncertainties for this case given the number of parties involved and the number of trials regarding this patent. In addition, and because much can change in ten months, the current trial date does not support denial. *See DISH Network v. Broadband iTV*, IPR2020-01280, Paper 17 at 16 (PTAB Feb. 4, 2021) (“We cannot ignore the fact that the currently scheduled trial date is more than nine months away and much can change during this time”).⁸

Moreover, given the existence of three cases each with multiple parties, to include multiple intervenors, the likelihood that any trials will be scheduled serially, the potential length of the trials given the number of patents at issue (11) and claims at issue, and post-trial motions, it is likely that the district court proceedings will not be complete before the final written decision in this matter. Indeed, these cases additionally will likely be delayed (as explained earlier) because third party defendant and patent owner KT has disputed jurisdiction, has yet to file an Answer

⁸ For these reasons, the “statistics on median time-to-trial for civil actions in the district court in which the parallel litigation resides” are not illuminating, given the number of cases and number of defendants.

and the Court has granted KT a protective order from non-jurisdictional discovery. EX1011.

Altogether, this factor weighs against discretionary denial.

c. Factor 3: Investment in the parallel proceeding by the court and the parties

Factor 3 weighs against discretionary denial. The district court cases are in their early stages and the district court has not issued any substantive rulings in either case with respect to the '460 Patent. Specifically, infringement contentions were served on March 18, 2024, invalidity contentions were served on May 17, 2024, and the claim construction hearing is not scheduled until March 11, 2025. EX1035, EX1030. In addition, third party defendant and patent owner, KT Corporation has not yet filed an answer, which will likely further delay progress on the merits.

Altogether, there is much work to be done in the district court and most, if not all, of the work will be well in the future. Accordingly, the district court will not invest significant resources related to the challenged patent prior to the issuance of an institution decision. *See Fintiv*, IPR2020-00019, Paper 11 at 9-12; *DISH Network*, IPR2020-01280, Paper 17 at 18-21.

d. Factor 4: Overlap between issues raised in the petition and in the parallel proceeding

Factor 4 favors institution. Indeed, there will not be complete overlap between this IPR and the district court cases because there are 12 claims asserted in this case

and a total of 113 asserted in the related district court cases. The district court will likely reduce the asserted claims prior to trial including some of the 12 claims at issue here. This factor thus weighs against the Board exercising its discretion to deny.

e. Factor 5: Whether the petitioner and the defendant in the parallel proceeding are the same party

Factor 5 is neutral as it is “far from an unusual circumstance that a petitioner in inter partes review and a defendant in a parallel district court proceeding are the same.” *Sand Revolution*, IPR2019-01393, Paper 24 at 12-13.

f. Factor 6: Other circumstances that impact the Panel’s exercise of discretion, including the merits

Factor 6 weighs strongly against discretionary denial. As detailed herein, this is a compelling case, and the merits of the Petition are strong. The challenges presented in this Petition are particularly compelling given that Grounds 1 and 3 are at least partially anticipatory, *i.e.*, Shen discloses all of the elements of the independent claims and Zhang discloses all of the elements of all Challenged Claims. §§VII.A, C. Grounds 2, 3, and 4 are a straightforward obviousness challenge based on Shen’s, Zhang’s, R1-1801080’s, Matsumura’s, Yin’s, TS 36.211’s, TS 36.213, and Jersenius’ express teachings. §§VII.B, C, D. Thus, Grounds 1-6 are straightforward and very strong and thus constitute compelling merits. *See, e.g., SRAM, LLC v. FOX Factory, Inc.*, IPR2024-00216, Paper 11 (PTAB Jun. 7, 2024) at p.55 (finding compelling merits where the anticipation ground is “seemingly

straightforward”), *Inergy Tech., Inc. v. Force Mos Tech., Co., Ltd.*, IPR2024-00094, Paper 9 (PTAB May 21, 2024) at p.36 (finding compelling merits where the obviousness ground is “seemingly straightforward” and “Petitioner’s motivation for this modification comes from an express teaching in [the cited reference]”). None of the grounds asserted herein were previously considered by either the Office or the district courts, also favoring institution. *See Comcast Cable Commn’s, LLC v. Rovi Guides, Inc.*, IPR2019-00231, Paper 14 at 11 (PTAB May 20, 2019) (obviousness challenges not “previously considered by the Office or any court” weigh in favor of not denying institution). Moreover, the ’460 Patent is currently asserted in three district court cases. Institution of this IPR would simplify the litigations for the district court.

2. The Board should not deny this Petition under §325(d)

The prior art documents cited in this Petition—Shen (EX1013), Matsumura (EX1019), Zhang (EX1020), Yin (EX1021, EX1022), Jersenius (EX1023), R1-1801080 (EX1017), TS 36.211 (EX1024), and TS 36.213 (EX1025)—were never considered or substantively discussed by the Patent Office during prosecution of the ’460 Patent. Accordingly, the Board should not exercise its discretion to deny this petition under §325(d).

The factors recited in *Becton, Dickinson & Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8 at 17 (PTAB Dec. 15, 2017) (precedential) weigh in favor

of institution. *Id.* at 4. In the present Petition, aspects of the prior art and arguments not considered by the USPTO due to material error during prosecution warrant institution. *See Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 at 8-9 (PTAB Feb. 13, 2020) (precedential). The Board has found such consideration without further analysis to be insufficient to exercise its discretion to not institute. *See e.g., Amgen Inc. v. Alexion Pharm., Inc.*, IPR2019-00740, Paper 15 (PTAB Aug. 30, 2019); *Scientific Design Co. v. Shell Oil Co.*, IPR2021-01537, Paper 7 (PTAB Mar. 18, 2022) and IPR2022-00158, Paper 7 (PTAB Apr. 4, 2022).

Furthermore, the Patent Office's lack of consideration of Shen, Zhang, Yin, TS 36.211, TS 36.213, and Jersenius is "material error" because the Patent Office overlooked the disclosures of such references that impact patentability of the Challenged Claims. *Advanced Bionics* at 8 n.9. The Board has consistently declined to discretionarily deny institution under similar facts. *See, e.g., DISH Network LLC v. Sound View Innovations, LLC*, IPR2020-01041, Paper 13, at 22 (PTAB Jan 19, 2021); *Roku, Inc. v. Universal Electronics, Inc.*, IPR2019-01615 (PTAB April 17, 2020); *Trans Ova Genetics, LC v. XY, LLC*, IPR2018-00250, Paper 9, at 18-19 (PTAB June 27, 2018).

With respect to factor (f), the Petition is supported by an expert declaration by Mark R. Lanning explaining how a POSITA would have understood Shen,

Matsumura, R1-1801080, Zhang, Yin, TS 36.211, TS 36.213, and Jersenius. EX1031, ¶¶34-356. This new evidence also weighs against discretionary denial. *See, e.g., Puma N. Am., Inc. v. Nike, Inc.*, IPR2019-01058, Paper 10, at 19 (PTAB Oct. 31, 2019).

IX. CONCLUSION

Petitioners have shown a reasonable likelihood of success. Therefore, this Petition should be granted, and the Board should institute trial.

Date: December 27, 2024

Respectfully submitted,

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APPENDIX A - LIST OF EXHIBITS

Exhibit No.	Description
1001	U.S. Patent No. 10,594,460, issued on March 17, 2020 (“the ’460 Patent”)
1002	File History of U.S. Patent Application No. 16/048,210, filed on July 27, 2018 (“the ’210 Application”)
1003	Korean Patent Application No. 10-2018-0057278, filed on May 18, 2018
1004	Certified English Translation of Korean Patent Application No. 10-2018-0057278 (“the ’278 Application”)
1005	Korean Patent Application No. 10-2017-0102577, filed on August 11, 2017
1006	Certified English Translation of Korean Patent Application No. 10-2017-0102577 (“the ’577 Application”)
1007	Korean Patent Application No. 10-2017-0095980, filed on July 28, 2017
1008	Certified English Translation of Korean Patent Application No. 10-2017-0095980 (“the ’980 Application”)
1009	Redlined Comparison of the ’460 Patent to Korean Patent Application No. 10-2017-0095980
1010	Redlined Comparison of the ’460 Patent to Korean Patent Application No. 10-2017-0102577
1011	Memorandum Opinion and Order, filed on December 12, 2024 in <i>Pegasus Wireless Innovation LLC v. Verizon Communications Inc., et al.</i> , Civ. Action No. 2:23-cv-00640 (E.D. Tex.)
1012	PCT International Publication No. WO 2019/136597, published on July 18, 2019

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1013	Certified English Translation of PCT International Publication No. WO 2019/136597 (“Shen”)
1014	U.S. Patent Publication No. 2012/0250653, published on October 4, 2012 (“Zhang ’653”)
1015	U.S. Patent Publication No. 2014/0169316, published on June 19, 2014 (“Kim”)
1016	U.S. Patent Publication No. 2015/0195069, published on July 9, 2015 (“Yi”)
1017	3GPP TSG RAN WG1 NR Ad Hoc Meeting, NTT DOCOMO, INC. January 22-26, 2018 (“R1-1801080”)
1018	PCT International Publication No. WO 2019/097659, published on May 23, 2019
1019	Certified English Translation of PCT International Publication No. WO 2019/097659 (“Matsumura”)
1020	PCT International Publication No. WO 2018/203727, published on November 8, 2018 (“Zhang”)
1021	PCT International Publication No. WO 2018/129085, published on July 12, 2018 (“Yin”)
1022	U.S. Provisional Application No. 62/442,864, filed on January 5, 2017 (“Yin ’864”)
1023	U.S. Patent Publication No. 2013/0322493, published on December 5, 2013 (“Jersenius”)
1024	Technical Specification, 3GPP TS 36.211 V11.6.0 (September 2014) (“TS 36.211”)
1025	Technical Specification, 3GPP TS 36.213 V11.6.0 (March 2014) (“TS 36.213”)
1026	Complaint filed in <i>Pegasus Wireless Innovation LLC v. Verizon Communications Inc., et al.</i> , Civ. Action No. 2:23-cv-00640 (E.D. Tex.) on December 29, 2023

Petition for *Inter Partes* Review of U.S. Patent No. 10,594,460

1027	Plaintiff and Counterclaim-Defendant Pegasus Wireless Innovation LLC's Initial Proposed Constructions in <i>Pegasus Wireless Innovation LLC v. Verizon Communications Inc., et al.</i> , Civ. Action No. 2:23-cv-00640 (E.D. Tex.) dated December 4, 2024
1028	Defendants and Intervenor's P.R. 4-2 Preliminary Claim Constructions and Extrinsic Evidence in <i>Pegasus Wireless Innovation LLC v. Verizon Communications Inc., et al.</i> , Civ. Action No. 2:23-cv-00640 (E.D. Tex.) dated December 4, 2024
1029	Protective Order from Non-Jurisdictional Discovery filed in <i>Pegasus Wireless Innovation LLC v. Verizon Communications Inc., et al.</i> , Civ. Action No. 2:23-cv-00640 (E.D. Tex.)
1030	Order modifying case deadlines for District Court Case Nos. 2:23-cv-00638, 2:23-cv-00639, 2:23-cv-00640
1031	Declaration of Mark Lanning
1032	<i>Curriculum Vitae</i> of Mark Lanning
1033	Declaration of Craig Bishop
1034	<i>Curriculum Vitae</i> of Craig Bishop
1035	First Amended Docket Control Order for District Court Case Nos. 2:23-cv-00638, 2:23-cv-00639, 2:23-cv-00640

CERTIFICATE OF COMPLIANCE WITH 37 C.F.R. §42.24

The undersigned hereby certifies that the foregoing Petition totals 13,994 words, excluding the parts which are exempted by 37 C.F.R. §42.24(a)(1).

Date: December 27, 2024

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that on this 27th day of December, 2024, a true and correct copy of the foregoing **PETITION FOR *INTER PARTES* REVIEW FOR U.S. PATENT NO. 10,594,460, EXHIBITS 1001-1035, and Petitioners' Powers of Attorney** are being served upon the Patent Owner at the following correspondence address of record via USPS Priority Mail:

IP LEGAL SERVICES, LLC
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Date: December 27, 2024

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