

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

**DECLARATION OF MARK LANNING IN SUPPORT OF PETITION FOR
INTER PARTES REVIEW OF U.S. PATENT NO. 10,594,460**

Declaration of Mark Lanning in Support of
Petition for *Inter Partes* Review of U.S. Patent No. 10,594,460

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- 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).” 59

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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
1012	PCT International Publication No. WO 2019/136597, published on July 18, 2019
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
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 Intervenors' 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
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

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I, Mark Lanning, hereby state as follows:

I. INTRODUCTION

1. I have been retained by 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”) as an independent expert consultant in this *inter partes* review (“IPR”) proceeding before the United States Patent and Trademark Office (“PTO”).

2. I have been asked by Counsel for Petitioners (“Counsel”) to consider whether certain references teach or suggest the features recited in Claims 1-12 (“the Challenged Claims”) of U.S. Patent No. 10,594,460 (“the ’460 Patent”) (EX1001). My opinions and the bases for my opinions are set forth below.

3. I understand that the ’460 Patent is assigned to KT Corporation, which has given an exclusive license to Pegasus Wireless Innovation LLC.

4. I have been asked to provide an independent analysis of the ’460 Patent in view of the asserted prior art publications cited in the Petition. This Declaration is limited to those issues.

5. I am not, and never have been, an employee of KT Corporation, Pegasus Wireless Innovation LLC, or Petitioners. I am not receiving compensation for this Declaration beyond my normal hourly fees based on my time actually spent

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analyzing and documenting my opinions herein on the '460 Patent, the asserted prior art publications cited in this Declaration and in the Petition, and the issues related thereto. My compensation is not related to the outcome of this proceeding, and I will not receive any additional compensation based on the outcome of any IPR or other proceeding involving the '460 Patent.

6. I am being compensated at my ordinary and customary consulting rate for my work, which is \$550 per hour. My compensation is in no way contingent on the nature of my findings, the presentation of my findings in testimony, or the outcome of this or any other proceeding. I have no other financial interest in this proceeding.

7. I have personal knowledge of the facts and opinions stated herein and, if called as a witness, could and would testify competently to them under oath.

II. BACKGROUND AND QUALIFICATIONS

8. All of my opinions stated in this declaration are based on my own personal knowledge and professional judgment. In forming my opinions, I have relied on my knowledge and experience.

9. I have extensive experience in the field of telecommunications including circuit-switched networks, multiple generations of cellular networks, and packet-switched networks.

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10. Further details on my education, work experience, and the cases in which I have previously given testimony in the past four years are contained in my *curriculum vitae* (EX1032).

11. I am currently the president of two consulting companies: Telecom Architects, Inc. and Reticle Consulting, LLC. Telecom Architects provides consulting services to fixed and wireless telecom service providers and their equipment suppliers. I have been President of Telecom Architects since 1999.

12. I have over 40 years of experience working in the telecommunications industry that began in the U.S. Army Signal Corp. My experience relevant to this case includes my work as an architect of various telecommunications systems and my work developing equipment used in telecommunications systems. This experience includes extensive design, implementation and testing work on the wireless interface functionality (between the base station and mobile phones) for multiple generations of cellular standards.

13. I received a Bachelor of Science (B.S.) degree in Computer Science from Southern Methodist University (SMU) in 1983.

14. Dynamic Services Controller (DSC), now a part of Alcatel, hired me in 1983 where I was a software development manager on the team responsible for ting

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DSC's PSTN telephone switch into a Mobile Switching Center (MSC) for Motorola to sell as a part of their cellular product offering in the U.S. and many other countries.

15. In 1991, I began working as a consultant to Motorola for its "SuperCell" base station product and as a consultant to British Telecom to upgrade its current analog cellular network and I was one of the network architects responsible for the design and rollout of its Global System for Mobile Communications (GSM) network known as Cellnet. Beginning in the early 1990s, I was responsible for implementation of the SMS service, including working with suppliers of the SMS Center (SMSC), Mobile Switching Centers (MSCs) and cellular phones to define and roll out the functionality that was to be provided.

16. I was personally involved with Nokia, Ericsson, Motorola and other equipment suppliers in this effort.

17. Since 1995, I have also provided second generation (2G) and third generation (3G) Code Division Multiple Access ("CDMA") network architecture and equipment design and implementation consulting services to companies such as Sprint, Nextel, Nokia, and Ericsson. While consulting to Nextel, which has since become part of Sprint, as one of the network architects for its iDEN network, one of my responsibilities was to define the network and mobile phone functionality required to support MMS and advanced data communications capability.

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18. In addition to my cellular experience listed above, for at least the past ten years, I have kept up to date my knowledge of the present-day 3G, 4G, and 5G cellular network and wireless standards and their associated equipment and protocols. I have done this through my study of each new release of these standards, technical books, and trade publications, as well as my expert work in legal cases, which has involved evaluating the functionality of many different types of network equipment, mobile devices, and baseband chipsets. I have also evaluated thousands of cellular technology patents and most of these were for cellular phone and/or base station functionality.

19. I am a member of the Institute of Electrical and Electronics Engineers (IEEE), including the IEEE Standards Association. I am also a member of the Association for Computing Machinery (ACM). While employed at DSC, I was a member of the ANSI T1 and T1X1 standard groups responsible for the definition and standardization of the Advanced Intelligent Network (AIN) and Signaling System 7 (SS7) protocol.

20. I was retained as a technical expert by 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”).

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21. I have also served as an expert in certain legal proceedings. A list of cases in which I have testified at trial, hearing, or by deposition is provided in EX1032, pp.7-10.

III. INFORMATION CONSIDERED

22. In preparation for this declaration, I have considered the materials discussed in this declaration, including, for example, the '460 Patent, the references cited by the '460 Patent, the prosecution histories of the '460 Patent and applications from which it derives (including the references cited therein), various background articles and materials referenced in this declaration, and the prior art references identified in this declaration. In addition, my opinions are further based on my education, training, experience, and knowledge in the relevant field.

IV. RELEVANT LEGAL STANDARDS

23. I am not an attorney and offer no legal opinions. For the purposes of this Declaration, I have been informed about certain aspects of the law that are relevant to my analysis, as summarized below.

A. Claim Interpretation

24. I have been informed that during an *inter partes* review proceeding, claims are to be construed in light of the specification as would be read by a person of ordinary skill in the relevant art at the time the application was filed. I have been informed that claim terms are given their ordinary and customary meaning as would

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be understood by a person of ordinary skill in the relevant art in the context of the entire disclosure. A claim term, however, will not receive its ordinary meaning if the patentee acted as his own lexicographer and clearly set forth a definition of the claim term in the specification. In that case, the claim term will receive the definition set forth in the patent.

25. I have been informed that certain patent claim terms may be interpreted as “means-plus-function” claim terms. I have been informed that terminology is part of the U.S. Patent Law in 35 USC §112, paragraph 6 (pre-AIA) / 35 USC §112(f) (post-AIA), which states the following: “An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.”

B. Perspective of One of Ordinary Skill in the Art

26. I have been informed that a patent is to be understood from the perspective of a hypothetical “person of ordinary skill in the art” (“POSITA”). Such an individual is considered to possess normal skills and knowledge in a particular technical field (as opposed to being a genius). I have been informed that in considering what the claims of a patent require, what was known prior to that patent,

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what a prior art reference discloses, and whether an invention is obvious or not, one must use the perspective of such a POSITA.

C. Anticipation

27. I have been informed that a claim is not patentable if it is anticipated. I have been informed that anticipation of a claim requires that every element of a claim is disclosed expressly or inherently in a prior art reference, arranged as in the claim, when considered from the perspective of a person of ordinary skill in the relevant art. I have been informed that when the structure recited in a reference is substantially identical to that of the claims, claimed properties or functions are presumed to be inherent. I have been informed that extrinsic evidence may be used to explain but not expand the meaning of terms and phrases used in the reference relied upon as anticipatory of the claimed subject matter.

D. Obviousness

28. I have been informed that a patent claim is obvious under 35 U.S.C. §103, and therefore invalid, if the claimed subject matter, as a whole, would have been obvious to a POSITA as of the priority date of the patent based on one or more prior art references and/or the knowledge of a POSITA.

29. I have been informed that an obviousness analysis must consider (1) the scope and content of the prior art, (2) the differences between the claims and the prior art, (3) the level of ordinary skill in the pertinent art, and (4) secondary

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considerations, if any, of non-obviousness (such as unexpected results, commercial success, long- felt but unmet need, failure of others, copying by others, and skepticism of experts).

30. I have been informed that a prior art reference may be combined with other references to disclose each element of the invention under 35 U.S.C. §103. I have been informed that a reference may also be combined with the knowledge of a POSITA, and that this knowledge may be used to combine multiple references. I have been informed that a POSITA is presumed to know the relevant prior art. I have been informed that the obviousness analysis may take into account the inferences and creative steps that a POSITA would employ.

31. In determining whether a prior art reference would have been combined with other prior art or other information known to a POSITA, I have been informed that the following principles may be considered:

- whether the references to be combined involve non-analogous art;
- whether the references to be combined are in different fields of endeavor than the alleged invention in the Patent;
- whether the references to be combined are reasonably pertinent to the problems to which the inventions of the Patent are directed;
- whether the combination is of familiar elements according to known methods that yields predictable results;

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- whether a combination involves the substitution of one known element for another that yields predictable results;
- whether the combination involves the use of a known technique to improve similar items or methods in the same way that yields predictable results;
- whether the combination involves the application of a known technique to a prior art reference that is ready for improvement, to yield predictable results;
- whether the combination is “obvious to try”;
- whether the combination involves the known work in one field of endeavor prompting variations of it for use in either the same field or a different one based on design incentives or other market forces, where the variations are predictable to a POSITA;
- whether there is some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill in the art to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention;
- whether the combination requires modifications that render the prior art unsatisfactory for its intended use;
- whether the combination requires modifications that change the principle of operation of the reference;
- whether the combination is reasonably expected to be a success; and
- whether the combination possesses the requisite degree of predictability at the time the invention was made.

32. I have been informed that in determining whether a combination of prior art references renders a claim obvious, it is helpful to consider whether there is some teaching, suggestion, or motivation to combine the references and a reasonable

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expectation of success in doing so. I have been informed, however, that a teaching, suggestion, or motivation to combine is not required.

V. SUMMARY OF OPINIONS

33. It is my opinion that Claims 1-12 of the '460 Patent are unpatentable on the following 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)	§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

VI. TECHNOLOGY BACKGROUND

34. 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 a “frequency hopping configuration information including a frequency hopping offset set which is composed of one or more frequency hopping offset values” for an uplink control

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channel and an uplink data channel received from a base station. *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 base station, constitutes the purported “inventive features” of the ’460 Patent. EX1026, ¶¶146-147, 149. However, as explained in §XIII, 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 base station.

VII. THE CHALLENGED ’460 PATENT CLAIMS

35. The ’460 Patent contains 12 claims. I have been asked to opine on the validity of Claims 1-12 (the “Challenged Claims”).

VIII. THE ’460 PATENT PROSECUTION HISTORY

36. I have reviewed the file history of the ’460 Patent.

37. 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

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US 2014/0169316 (“Kim”) (EX1015), US 2012/0250653 (“Zhang ’653”) (EX1014),¹ and US 2015/0195069 (“Yi”) (EX1016). EX1002, pp.109-124.

38. 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 UL grant downlink control information (DCI)”. *Id.*, pp.91-99.

39. 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.*

40. In particular, Applicant argued that the term “frequency hopping offset set composed of one or more frequency hopping offset values” means that “the

¹ 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.

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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**.

41. I understand that the 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.

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42. The prior art cited in this Petition discloses the features alleged to be missing from art applied during prosecution.

IX. PRIORITY DATE

43. I have been informed that the “priority date” or “earliest effective filing date” of a patent is the date on which it is filed, or the date on which an earlier-filed U.S. or international patent application was filed if the patentee claims the benefit of priority to that earlier-filed U.S. or international patent application.

44. I have also been informed that claims in a patent or patent application are not entitled to priority at least until the patent owner proves entitlement to the PTO, the Board, or a federal court. I have been informed that 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. I have been informed that 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. I have been informed that 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). I have been informed that “[o]ne shows that one is ‘in possession’ of the invention by describing

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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). I have been informed that, “[p]ut 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). I have also been informed that 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.

45. The ’460 Patent issued from U.S. Patent Application No. 16/048,210, filed on July 27, 2018, and claims priority to three Korean patent applications: Korean Patent Application No. 10-2017-0095980, filed on July 28, 2017 (the “’980 Application”), Korean Patent Application No. 10-2017-0102577, filed on August 11, 2017 (the “’577 Application”), and Korean Patent Application No. 10-2018-0057278, filed on May 18, 2018 (the “’278 Application”). As discussed below, it is my opinion that the Challenged Claims are not entitled to a priority date before May 18, 2018—the latest of the three priority applications.

46. First, neither the ’980 Application nor the ’577 Application disclose the limitation 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***

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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].

47. The '980 Application and the '577 Application lack the following supporting disclosures from the '460 Patent:

The UE may transmit a UL control channel and a UL data channel to the BS through the transmission BWP on the basis of the BWP configuration information and the frequency hopping configuration information [which includes the frequency hopping offset set which is composed of one or more frequency hopping offset values]

and

the BS may receive a UL control channel and a UL data channel from the UE through the reception BWP on the basis of the BWP configuration information and the frequency hopping configuration information [which includes the frequency hopping offset set which is composed of one or more frequency hopping offset values].

EX1001, 13:27-30, 15:4-7; *see also* EX1009, ¶¶[0008-0011], [0108-109], [0114], [0119], [0135], [0140], [0158], [0163], [0180], [0185];

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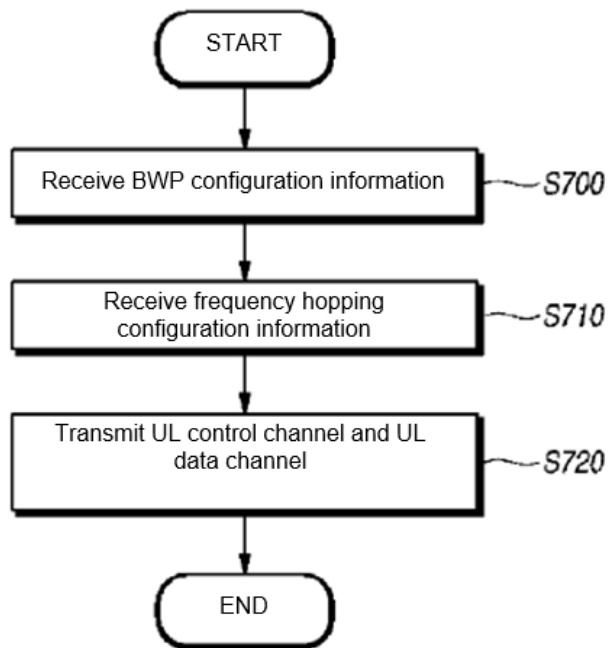
EX1010, ¶¶[0009-0011], [0108-109], [0114], [0119], [0135], [0140],
[0158], [0163], [0180], [0185].

48. The terms “frequency hopping configuration information” and “frequency hopping offset set” do not appear in the ’980 or the ’577 Applications.

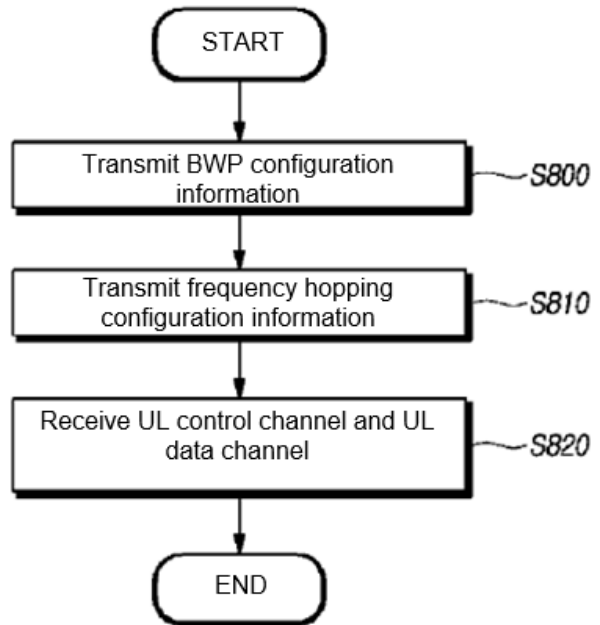
49. In addition, Figs. 7 and 8 of the ’460 Patent (reproduced below), to which the disclosures cited above relate, were disclosed for the first time in the ’278 Application, filed on May 18, 2018. EX1004, p.34; EX1009, ¶¶[0019-20], [0099-141]; EX1010, ¶¶[0019-20], [0099-141].²

² 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.

[FIG. 7]



[FIG. 8]



50. In particular, the description for step S710 in Fig. 7 states: “Further, the UE may receive frequency hopping configuration information for a UL control channel and a UL data channel transmitted through one transmission BWP of the BWP set from the BS (S710).” *Id.*, ¶ [0112]. The description for step S720 of Fig. 7 states: “The UE may transmit a UL control channel and a UL data channel to the BS through the transmission BWP on the basis of the BWP configuration information and the frequency hopping configuration information (S720).” *Id.*, ¶ [0123].

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51. Steps S710 and S720 do not appear in the '980 Application or in the '577 Application, but were disclosed for the first time in the '278 Application, filed on May 18, 2018. *Id.*, ¶¶[0112]; [0123].

52. Likewise, the description for step S820 in Fig. 8 states: “Further, the BS may receive a UL control channel and a UL data channel from the UE through the reception BWP on the basis of the BWP configuration information and the frequency hopping configuration information (S820).” *Id.*, ¶[0145].

53. Step S820 does not appear in the '980 Application or in the '577 Application, but was disclosed for the first time in the '278 Application, filed on May 18, 2018. *Id.*, ¶¶[0145].

54. No other disclosure in the '980 or '577 Applications provides written description support for these claim limitations.

55. Thus, it is my opinion that the '980 Application and the '577 Application do not provide written description support for the features “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” or “receiving the UL control channel and the UL data channel from the UE through the reception BWP based on the BWP

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configuration information and the frequency hopping configuration information” in Claims 1, 5, and 9 of the ’460 Patent.

56. Second, neither the ’980 Application nor the ’577 Application disclose the limitation in Claims 1, 5, and 9 requiring “a frequency hopping offset set composed of one or more frequency hopping offset values.”

57. The ’980 and the ’577 Applications lack the 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].

58. Rather, in every embodiment in the ’980 and ’577 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.

59. 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.

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60. 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].

61. Thus, the ’980 Application and the ’577 Application do not provide written description support for the features “a frequency hopping offset set composed of one or more frequency hopping offset values” in Claims 1, 5, and 9 of the ’460 Patent.

62. No other disclosure in the ’980 or ’577 Applications provides written description support for this claim limitation.

63. The ’980 and ’577 Applications mention “candidate values for corresponding hopping offset values.” EX1006, page 14, line 30; EX1008, ¶[0054]. However, the described “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, not “frequency hopping offset values.” EX1006, p.14, l.30; EX1008, ¶[0054].

64. For example, the “Method 2” embodiment introduced in the ’577 Application describes allocating a “frequency hopping bandwidth” for the PUCCH for each UE. EX1006, 13:8-24. Although “Method 2” mentions “candidates,” these candidates are not related to the required “frequency hopping offset values,” but to

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PUCCH frequency hopping, which “may be defined by a **bandwidth of a bandwidth part, a system bandwidth** of an NR CC, or the like ...” *Id.*, 14:2-9.

65. Thus, it is my opinion that the “candidate values” disclosed in the ’980 Application and the ’577 Application relate to the whole bandwidth available to the UE for frequency hopping, for either a bandwidth part or a system bandwidth, and not to frequency hopping offset values.

66. The ’980 and ’577 Applications also fail to provide written descriptive support for Claims 2-4, 6-8, 10-12.

67. First, the ’980 and ’577 Applications fail to provide support for the limitation in Claims 2, 6, and 10 requiring that “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.” These features were disclosed for the first time in the ’278 Application, filed on May 18, 2018. EX1004, ¶¶[0113], [0115], [0136-137], [0160-161], [0183-184]; *see also* EX1009, ¶¶[0109], [0111], [0131-132], [0154-155], [0176-177]; EX1010, ¶¶[0109], [0111], [0131-132], [0154-155], [0176-177].

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68. No other disclosure in the '980 or '577 Applications provides written description support for these claim limitations.

69. Thus, it is my opinion that the '980 Application and the '577 Application do not provide written description support for Claims 2, 6, and 10 of the '460 Patent.

70. Second, the '980 and '577 Applications fail to provide support for the limitation in Claims 3, 7, and 11 requiring that “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.”

71. Nor do the '980 Application or the '577 Application include the disclosure in the '460 Patent: “Here, *the frequency hopping offset values may be indicated as the numbers of PRBs*” EX1001, 14:42-46; 16:21-25; 17:65—18:2; *see also* EX1009, ¶¶[0114], [0135], [0158], [0180]; EX1010, ¶¶[0114], [0135], [0158], [0180]. A new “Embodiment 3: Method of Separately Allocating Frequency Resources (*e.g.*, PRBs) for Each Frequency Hop” that discloses these features was disclosed for the first time in the '278 Application, filed on May 18, 2018. EX1004, ¶¶[0096-0193].

72. No other disclosure in the '980 or '577 Applications provides written description support for this claim limitation.

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73. Thus, the '980 Application and the '577 Application do not provide written description support for 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” in Claims 3, 7, and 11 of the '460 Patent.

74. Third, neither the '980 Application nor the '577 Application disclose the limitation in Claims 4, 8, and 12 requiring 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.”

75. Neither the '980 Application nor the '577 Application discloses any embodiments in which the “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.” EX1009, ¶¶[0116], [0137], [0160], [0182]; EX1010, ¶¶[0116], [0137], [0160], [0182].

76. A new “Embodiment 3: Method of Separately Allocating Frequency Resources (*e.g.*, PRBs) for Each Frequency Hop” that discloses these features was

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disclosed for the first time in the '278 Application, filed on May 18, 2018. EX1004, ¶¶[0096-0193].

77. No other disclosure in the '980 or '577 Applications provides written description support for this claim limitation.

78. Thus, the '980 Application and the '577 Application do not provide written description support for the features “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” in Claims 4, 8, and 12 of the '460 Patent.

79. Therefore, it is my opinion that Patent Owner is not entitled to a priority date before the filing date of the '278 Application, May 18, 2018.

X. LEVEL OF ORDINARY SKILL IN THE ART

80. A POSITA 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.

81. A person with a different degree, but with additional relevant experience, could still qualify as a POSITA if the additional experience compensates for the different educational background.

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82. A person with less than 2 years of experience working in a field involving wireless communications could still qualify as a POSITA if the person has additional education that compensates for their lesser experience.

XI. CLAIM CONSTRUCTION

83. For purposes of my analysis in this IPR proceeding, I have been informed that terms that appear in the claims of the '460 Patent should be interpreted according to their plain and ordinary meaning under the *Phillips* standard. In determining the ordinary and customary meaning, I have been informed that the words of a claim are first given their plain meaning that those words would have had to a POSITA at the time of the alleged invention. I also have been informed that the claims, specification, and file history may be used to better construe a claim insofar as the plain meaning of the claims cannot be understood. I have been informed that even treatises and dictionaries may be used under limited circumstances to determine the meaning attributed by a POSITA to a claim term at the time of filing.

84. I also understand that, for terms that evoke a means plus function construction, “the construction of the claim must identify the specific portions of the specification that describe the structure, material, or acts corresponding to each claimed function.” 37 C.F.R. §42.104(b)(3). I understand from Counsel that construing a means-plus-function claim term is a two-step process that includes (1)

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identifying the claimed function and (2) then determining what structure, if any, disclosed in the specification corresponds to the claimed function.

85. I have reviewed the '460 Patent and its prosecution history, as well as additional documents, to construe the claims for performing my validity analysis. It is my understanding that some terms of the '460 Patent are in dispute in a related litigation. Below is a summary of claim constructions I have made for purposes of evaluating the Challenged Claims of the '460 Patent.

86. I understand that in the 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 of the application underlying the '460 Patent requiring “multiple” frequency hopping

offset values. I adopt these constructions proposed in the Related Litigation for purposes of this Expert Declaration.

87. 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.

88. The Challenged Claims are unpatentable under all potential constructions.

XII. OVERVIEW OF THE PRIOR ART REFERENCES

A. Shen (EX1013)

89. Shen discloses a method for establishing a frequency hopping configuration, by a network device (*e.g.*, base station) for a terminal (*e.g.*, user equipment or UE), of a Bandwidth Part (“BWP”) in a 5G New Radio (“NR”) system. *See* EX1013 in its entirety; *Id.*, 1:3-10.

90. Shen discloses: (A) transmitting, by the UE to the BS, a physical channel, such as a Physical Uplink Shared Channel (“PUSCH”) for data information and a Physical Uplink Control Channel (“PUCCH”) for control information; (B) receiving, by the UE, from the BS, configuration information indicating how to configure at least one BWP and the position of each BWP in a BWP set composed of one or more BWPs configured for the UE; (C) receiving, by the UE, from the BS, frequency hopping configuration information indicating at least one frequency

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domain offset for a transmission physical channel, such as a PUSCH and a PUCCH, configured for each BWP in at least one BWP of the BWP set; and (D) transmitting, by the UE to the BS, the uplink physical data and control channels, respectively the PUSCH and the PUCCH, on a frequency domain resource for transmitting the uplink physical channels in the activated BWP according to the bandwidth for the activated BWP. EX1013, 5:21-23, 5:26-28, 7:5-8, 8:27-31, 8:36-37, 9:12-14, 13:27-36.

91. Shen configures two different frequency domain offset values W_{offset1} and W_{offset2} for different BWPs. *Id.*, 5:15-18; 7:25-32; 8:3-7.

92. The frequency hopping offset value used to transmit the physical channel, such as a PUSCH and a PUCCH, in the activated BWP is indicated through Downlink Control Information (“DCI”) sent by the network device (*e.g.*, base station) to the terminal. *Id.*, 5:1-10.

B. Matsumura (EX1019)

93. Matsumura discloses a method for frequency hopping of an uplink control channel (“PUCCH”) and an uplink data channel (“PUSCH”) to configure, per user terminal, an access Bandwidth (“BW”) or a Bandwidth Part (“BWP”) in the 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], [0006], [0030].

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94. Matsumura discloses: (A) transmitting, by a user terminal (*e.g.*, user equipment), an uplink data channel, such as a Physical Uplink Shared Channel (“PUSCH”) and an Uplink Control Information (“UCI”) by using a Physical Uplink Control Channel (“PUCCH”), for example; (B) receiving, by the terminal, from a radio base station, a BWP configured for the user terminal; (C) receiving, by the terminal, from the radio base station, frequency resource information indicating a frequency offset, so that the user terminal can appropriately control a frequency hopping pattern based on the frequency resource information; and (D) transmitting the PUCCH, to the radio base station, based on the PUCCH resource set indicated by the DCI. EX1019, ¶¶[0004-10], [0029-32], [0048-50], [0061-66], [0094].

95. Matsumura specifically configures, in a BWP configured for the user terminal, a frequency resource information (*e.g.*, information indicating a frequency offset), when frequency hopping is enabled. EX1019, ¶¶[0069], [0085].

96. The frequency resource information may include information indicating an index of a physical resource block (“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). *Id.*, ¶¶[0068-69].

97. The allocated frequency resources of the PUCCH/PUSCH may be indicated by a higher layer signaling and/or DCI sent by the radio base station to the terminal. *Id.*, ¶[0040].

98. The 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 (“ $1/2 * S$ ”, “ $+1/4 * S$ ”, and “ $-1/4 * S$ ”, Fig. 14C). *Id.*, ¶¶[0114-121].

99. 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].

C. R1-1801080 (EX1017)

100. 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.

101. For PUSCH transmission with UL grant, frequency hopping offsets in the frequency domain are explicitly configured by UE-specific RRC signaling. *Id.*, §2.3, p.2/33.

102. 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. *Id.*

D. Zhang (EX1020)

103. Zhang discloses methods for allocating uplink resources, such as Bandwidth Part (“BWP”) resources and intra-BWP Physical Resource Block (“PRB”) resources, from a base station to a user equipment (“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], [0056], [0223-224]; Fig. 5.

104. Zhang discloses: (A) transmitting, by the UE to the base station, UL data on a Physical Uplink Shared Channel (“PUSCH”) and a Message 3 (“Msg3”) that contains information, such as a user equipment identifier and a Radio Resource Control (“RRC”) link request, on a Physical Uplink Control Channel (“PUCCH”); (B) receiving, by the UE, from the base station, an uplink grant that includes BWP resource indication information and intra-BWP PRB resource indication information allocated by the base station to the UE; (C) receiving, by the UE, from the base station, frequency hopping configuration information (*e.g.*, no frequency hopping or frequency hopping, and three different ways for PRB allocation: continuous allocation of PRBs, discontinuous allocation of PRBs, and partially continuous

allocation of PRBs) located in the at least one of the BWP indication information and the intra-BWP PRB resource indication information; and (D) transmitting UL data on the PUSCH or control information on the PUCCH, to the base station, based on the frequency hopping resource allocation information and the PRB resources used for uplink transmission allocated within the uplink BWP. *Id.*, ¶¶[0010-12], [0020-22], [0163-0171], [0210], [0223-227], [0287-295].

105. Zhang specifically configures a frequency hopping resource allocation information, such as one or more resource block group (“RBG”) resources within a RBG set, to a certain UE. *Id.*, ¶¶[0172], [0458].

106. For example, the base station 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, both of which are included in the intra-BWP PRB resource allocation information to be transmitted in the UL grant. *Id.*, ¶¶[0056], [0224], [0326-328], [0445], [0458].

107. The intra-BWP PRB resource allocation information may include a fixed bit of RBG offset indication for different BWPs. *Id.*, ¶[0460].

108. The UE can obtain a starting Physical Resource Block (“PRB”) location (“RBSTART”) and the number (“LCRBs”) of allocated continuous PRBs according to a Resource Indication Value (“RIV”) and a corresponding calculation method,

depending on whether a frequency hopping flag is 0 (only the RIV is included in the resource allocation indication) or 1 (the resource allocation indication includes both the frequency hopping resource allocation information and the RIV). *Id.*, ¶[0172].

E. Yin (EX1021)

109. 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], [0085]; EX1022, ¶¶[0104-107].

110. Yin discloses: (A) transmitting, by a UE to a base station (gNB), uplink control information (UCI) or data using one or more uplink channels, such as a Physical Uplink Control Channel (“PUCCH”) and a Physical Uplink Shared Channel (“PUSCH”); (B) receiving, by the UE, from the base station, an uplink grant that includes separate PUCCH regions or subbands allocated by the base station to the UE; (C) receiving, by the UE, from the base station, frequency hopping configuration information (*e.g.*, the number of resource blocks (RBs) for a UL control channel (PUCCH) region/subband); and (D) transmitting UL control information (UCI), to the base station, on a PUCCH resource corresponding to the PUCCH resource configuration within the selected set of PUCCH resource

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configurations. EX1021, ¶¶[0052-54], [0058], [0064], [0085], [0098], [0105], [0216]; EX1022, ¶¶[0044-46], [0050], [0056], [0077], [0090], [0097], [0202].

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

111. 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.

112. 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.

G. Jersenius (EX1023)

113. Jersenius describes methods for allocating radio resources to user equipment using Type 1 PUSCH 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], [0047-48], [0050].

114. Jersenius discloses: (A) transmitting, by a UE to a base station, a scheduling request to initiate data uplink transfer over a Physical Uplink Control Channel (“PUCCH”) and a Physical Uplink Shared Channel (“PUSCH”); (B) receiving, by the UE, from the base station, an uplink grant that includes a bandwidth divided into subbands allocated by the base station to the UE; (C) receiving, by the

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UE, from the base station, frequency hopping configuration information (*e.g.*, a flag for indicating frequency hopping is on or off or information of the allocation of the radio resource in form of a virtual resource allocation); and (D) transmitting data, to the base station, using the allocated radio resource. EX1023, ¶¶[0040], [0050-51], [0056], [0084].

**XIII. DETAILED EXPLANATION OF THE UNPATENTABILITY
GROUNDS**

115. In my opinion, the Challenged Claims are unpatentable over the prior art.

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

116. The following sections reference where elements of Claims 1, 3, 5, 7, 9, and 11 are anticipated by the prior art.

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”

117. Shen discloses or renders obvious the preamble of Claim 1.

118. Shen discloses a method for a user equipment (UE), represented as “terminal” (EX1013, Abstract, 3:3-4), to transmit an uplink (UL) control channel, such as Shen’s “physical uplink control channel (PUCCH)”, and a UL data channel, such as Shen’s “physical uplink shared channel (PUSCH)”, to a base station (BS), represented as “network device” (*Id.*, 3:3-4). EX1013, 5:21-28, 7:5-8. Shen is

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directed to improving “the transmission performance of physical channels.” *Id.*, 3:16-17.

119. The PUSCH is a recognized “UL data channel” in the ’460 Patent’s background section (UL configured data channel such as “a physical uplink shared channel (PUSCH), etc., such that data is transmitted”), as confirmed by the Matsumura document cited herein. EX1019, ¶[0004]; EX1001, 4:31-34. 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;”

120. Shen discloses or renders obvious Element [1.1].

121. Shen discloses receiving, from the BS, a Bandwidth Part (“BWP”) configuration information of a BWP set composed of one or more BWPs configured for the terminal. 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 (“the network device may further transmit a second configuration information to the terminal to be used to indicate the configuration of the at least one BWP”); 9:12-14; Fig. 2B.

122. Specifically, Shen discloses “[i]n 101, the network device may specifically transmit the first configuration information of the transmission physical

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channel to the terminal, wherein the first configuration information is used to indicate at least one frequency domain displacement separately configured for each of at least one BWP.” EX1013, 5:21-23; Fig. 1 (reproduced below):

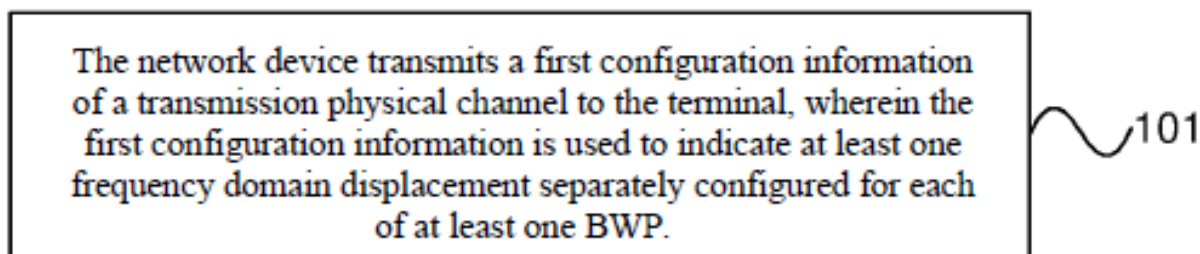


Fig. 1A

123. Shen discloses that “the network device may further transmit a second configuration information to the terminal to be used to indicate the configuration of at least one BWP. After the terminal receives the second configuration information, it can determine the position of each of at least one BWP.” EX1013, 6:4-6. Further, “after the terminal receives the second configuration information, it can determine the position of each of the at least one BWP.” EX1013, 6:4-5.

124. Shen discloses receiving configuration information to the terminal to be used to indicate the configuration of the at least one BWP, and this configuration information is used as BWP configuration information to configure one or more BWPs of a BWP set. EX1013, 5:21-23; 6:4-6; 9:12-14; Fig. 2B.

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125. 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 determine a position of each BWP in the BWP set. *Id.*, 6:4-6.

126. The '460 Patent describes: "BWP configuration information is information on the BWP set composed of one or more BWPs configured for the UE." EX1001, 13:39-42. Further, "configuration information of each BWP of the BWP set may include a starting RB index, that is, a starting point of the BWP, based on the common RB indexing information." *Id.*, 14:3-7.

127. Like the '460 Patent, Shen also discloses BWP configuration information: "the network device may further transmit a second configuration information to the terminal to be used to indicate the configuration of the at least one BWP." EX1013, 6:4-5. "After the terminal receives the second configuration information, it can determine the position of each of the at least one BWP." EX1013, 6:5-6.

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"

128. Shen discloses or renders obvious Element [1.2].

129. Shen discloses receiving, from the BS, frequency hopping configuration information designated as "at least one frequency domain

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displacement” (EX1013, 6:17-29) (i.e., offset) for a UL control channel (designated “PUCCH” in Shen) and a UL data channel (designated “PUSCH” in Shen). EX1013, 4:14-22; 5:19-31; 6:20-37; Fig. 1A. Shen’s UL control and data channels (PUSCH, PUCCH) 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***”). Element [1.3] *infra* confirms that it is the UL control/data channels (i.e., PUCCH, PUSCH) which are transmitted through the “transmission BWP.” A POSITA would have understood that “frequency domain displacement is “frequency hopping configuration information.” The “frequency domain displacement” information refers to a frequency domain offset between two hops of frequency hopping.” EX1013, 8:34-35. “[T]he frequency domain displacement information refers to the ***frequency domain displacement between two hops of frequency hopping***, which can be expressed by number of RBs.” EX1013, 8:34-35. Further, the terminal “***receives*** a first configuration information of a transmission physical channel, transmitted by the network device, wherein the first configuration information is used to indicate at least one frequency domain displacement separately configured for each of at least one BWP.” EX1013, 8:29-31. “[T]he terminal determines at least one frequency domain displacement for each BWP based on the first configuration

information.” 8:32-33. PUSCH represents a “UL data channel” as claimed. EX1019, ¶[0004]; EX1001, 4:31-34.

130. Shen further discloses that the UL control channel and UL data channel are transmitted through one transmission BWP of the BWP set. EX1013, 13:29-34. Specifically, Shen discloses:

Optionally, according to one possible method for achieving this embodiment, as shown in Fig. 4B, the network device provided in this embodiment may further include a transmitting unit 43, which can be used to determine the position of the second frequency domain resource of the ***physical channel to be transmitted in the activated BWP*** based on the bandwidth of the activated BWP, the utilized frequency domain displacement, and the position of the first frequency domain resource of the physical channel to be transmitted in the activated BWP, using the formula $R2 = (R1 + W_{\text{displacement}}) \bmod W$; wherein R2 is the position of the second frequency domain resource in the activated BWP; R1 is the position of the first frequency domain resource in the activated BWP; $W_{\text{displacement}}$ is the utilized frequency domain displacement; W is the bandwidth of the activated BWP. Additionally, the transmitting unit 43 can transmit the [information of] the physical channel to the network device, while [transmitting] the first frequency domain resource and the second frequency domain resource.

EX1013, 13:27-36.

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131. Further, the '460 Patent describes that “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. Similar, “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. Here, the frequency hopping offset values may be indicated as the numbers of PRBs.” *Id.*, 12:63-67.

132. Shen’s frequency domain displacement teaches or renders obvious the frequency hopping configuration information of the '460 Patent. “[F]requency domain displacement refers to the frequency displacement between two hops of frequency hopping, which can be expressed by number of resource blocks.” EX1013, 5:24-25.

133. To the extent Patent Owner argues that 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

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hopping configuration information through higher layer signaling (e.g., RRC signaling).” EX1001, 15:8-10.

134. Regardless, Shen similarly teaches that its 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.

135. Therefore, Shen discloses 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.

136. Shen further discloses that the “frequency domain displacement” information, which refers to a frequency domain offset between two hops of frequency hopping, and may be expressed by the number of Resource Blocks (RB), is transmitted from the base station to the UE in at least the “first configuration information” through “high-level signaling or system broadcast message,” such as “radio resource control (RRC) signaling.” EX1013, 5:29-37; 6:9-13.

137. The RRC signaling protocol messages, which include the downlink control information (DCI) messages (*Id.*, 6:17-22), are transmitted to the UE over a downlink control channel, such as a Physical Downlink Control Channel (PDCCH),

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which Shen states is one of the “physical channel[s]” configured for each BWP. *Id.*, 5:19-28.

138. Therefore, the RRC signaling protocol messages, which contain the Downlink Control Information (DCI) used by the base station to specify many UE configuration parameters, including the frequency hopping requirements are transmitted on the PDCCH, which, as taught by Shen, is transmitted through the BWP (i.e., inside the BWP frequency range) to transfer the frequency hopping configuration to the UE. *Id.*, 5:21-37. Shen therefore discloses that frequency hopping configuration information is transmitted through one transmission BWP of the BWP set. *Id.*, 5:21-37.

139. Thus, A POSITA would understand that UE configuration parameters are included in DCI which is transmitted through higher layer signaling, such as RRC signaling. A POSITA would understand DCI is transmitted through the physical downlink control channel PDCCH. Shen discloses that physical channels, like PDCCH, are transmitted through an activated BWP. Therefore, Shen discloses that frequency hopping configuration information is transmitted through the transmission BWP.

140. A POSITA would understand that by disclosing that frequency domain displacement information is transmitted through RRC signaling, and that BWP

configuration information is transmitted through RRC signaling, Shen also teaches that frequency hopping information is transmitted through transmission BWP.

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,”

141. Shen discloses or renders obvious Element [1.3].

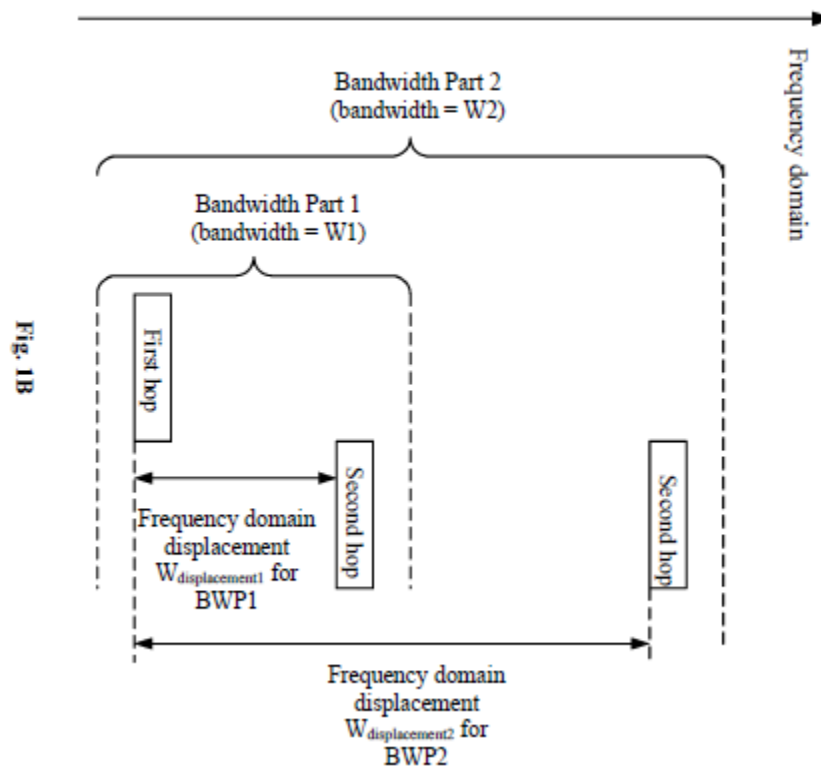
142. Shen discloses transmitting a UL control channel and a UL data channel (i.e., Shen’s “PUCCH” and “PUSCH” control/data channels) to the BS through a transmission BWP designated in Shen as the “activated BWP,” based on the BWP configuration information (information used to configure the BWP) and the 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:

Optionally, according to one possible method for achieving this embodiment, following 201, the terminal 19 may further determine the position of the second frequency domain resource of the physical channel to be 20 transmitted in the activated BWP based on the bandwidth of the activated BWP, the utilized frequency domain 21 displacement, and the position of the first frequency domain resource of the physical channel to be transmitted in 22 the activated BWP, using the formula $R2 = (R1 + W_{\text{displacement}}) \bmod W$; wherein $R2$ is the position

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of the second 23 frequency domain resource in the activated BWP; R_1 is the position of the first frequency domain resource in the 24 activated BWP; $W_{\text{displacement}}$ is the utilized frequency domain displacement; W is the bandwidth of the activated 25 BWP; thus, the terminal may transmit the physical channel to the network device over the first frequency domain 26 resource and the second frequency domain resource.

EX1013,10:19-27.



143. Frequency domain displacement information refers to frequency hopping configuration information. As described in the '460 Patent, “frequency hopping configuration information for a UL control channel may include at least one

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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. Similar, “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. Here, the frequency hopping offset values may be indicated as the numbers of PRBs.” *Id.*, 12:63-67.

144. Shen’s frequency domain displacement teaches or renders obvious the frequency hopping configuration information of the ’460 Patent. “[F]requency domain displacement refers to the frequency displacement between two hops of frequency hopping, which can be expressed by number of resource blocks.” EX1013, 5:24-25.

145. Shen discloses that $W_{\text{displacement}}$ indicates the utilized frequency domain displacement (EX1013, 10:19-27), which a POSITA would understand is the frequency hopping configuration information.

146. Shen’s terminal *transmits* “the physical channel to the network device” using the frequency hopping configuration information and the BWP configuration information. EX1013, 10:26-27. $W_{\text{displacement}}$ is frequency hopping configuration information. §XIII.A.1.b.

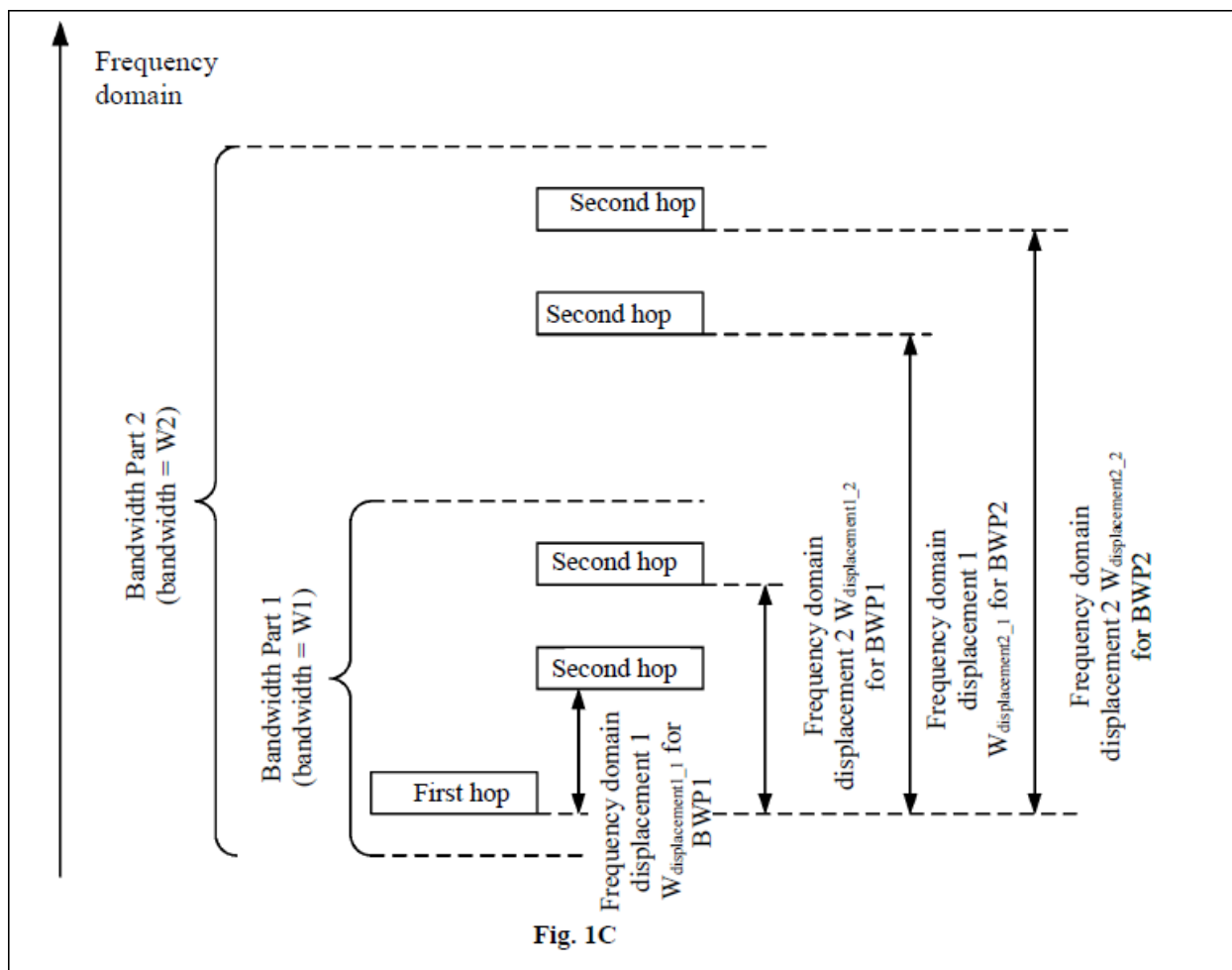
d. Element [1.4]: “wherein the frequency hopping configuration information for a UL data channel includes a frequency hopping offset set composed of one or more frequency hopping offset values, and”

147. Shen discloses or renders obvious Element [1.4] as construed in §XI.

148. Shen discloses that its 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.

149. Shen’s “frequency domain displacement 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. Fig. 1C of Shen (reproduced below) illustrates “[f]or BWP1, two frequency domain displacements, $W_{\text{displacement1_1}}$ and $W_{\text{displacement1_2}}$, are configured, and for BWP2, two frequency domain displacements, $W_{\text{displacement2_1}}$ and $W_{\text{displacement2_2}}$, are configured.” *Id.* “In 201, the terminal receives a first confirmation information of a transmission physical channel, transmitted by the network device, wherein the first configuration information is used to indicate at least one frequency domain displacement

separately configured for each of at least one BWP.” EX1013, 8:29-31. Shen’s configuration information indicates “at least one frequency domain displacement separately configured for each of at least one BWP.” *Id.*, 8:29-31.



150. 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. §VIII.

- 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).”**

151. Shen discloses or renders obvious Element [1.5].

152. Shen discloses that the 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) included in the frequency hopping offset set (i.e., “frequency domain displacement set, *Id.*, 5:15-18; 7:25-32) is indicated by the network device (BS) to the terminal (UE) by UL grant downlink control information (“DCI”). Shen states that its “DCI” indicates “frequency domain displacement” information (i.e., a frequency hopping offset value). *Id.*, 6:17-7:2; 10:1-7.

153. Referring to Fig. 1A, Shen discloses “according to one possible method for achieving this embodiment, following 101, the network device may further transmit a second control information to the terminal, wherein the second control information is used to indicate a utilized frequency domain displacement in at least one frequency domain displacement.” *Id.*, 6:25-27. “In this way, after the terminal receives the second control information, it can determine the utilized frequency domain displacement of the activated BWP.” *Id.*, 6:27-29. “Specifically, the network

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device may transmit the second control information to the terminal through DCI or higher-layer signaling.” *Id.*, 7:1-2.

154. Further still, Shen discloses “Fig. 1C is a schematic diagram of another frequency domain displacement configuration provided in the corresponding embodiment shown in Fig. 1A.” *Id.*, 8:3-4. As shown in Fig. 1C, assume that two BWPs, namely BWP1 and BWP2, are configured for the terminal, wherein BWP1 has a bandwidth of W_1 and BWP2 has a bandwidth of W_2 .” EX1013, 8:4-5. “For BWP1, two frequency domain displacements, $W_{\text{displacement1_1}}$ and $W_{\text{displacement1_2}}$, are configured, and for BWP2, two frequency domain displacements, $W_{\text{displacement2_1}}$ and $W_{\text{displacement2_2}}$, are configured.”

155. A POSITA would understand that these frequency domain displacements are frequency hopping offset values described in the ’460 Patent. In the ’460 Patent, frequency hopping offset values “may be indicated as the numbers of PRBs.” EX1001, 12:66-67; *see also Id.*, 14:45-46, 16:24-25, 18:1-2. Similarly, Shen discloses “frequency domain displacement refers to the displacement between two hops in frequency hopping, which can be expressed by numbers of resource blocks (RBs).” EX1013, 5:24-25. A POSITA would understand that Shen’s “RBs” or “Resource Blocks” refer to the ’460 Patent’s “PRBs” or “Physical Resource Blocks.” *Id.*; EX1001, 10:35-44 (in one embodiment, explaining PRBs: “the

BS/network may dynamically indicate an offset value (e.g., a physical resource block (PRB) offset value)...”).

156. “In order to make the method provided by the embodiments of the present disclosure clearer, the following examples will illustrate configurations of different frequency domain displacements for different BWPs and configuration of two different frequency domain displacement sets.” EX1013, 7:25-27. “Fig. 1B is a schematic diagram of a frequency domain displacement configuration provided in the corresponding embodiment shown in Fig. 1A.” *Id.*, 7:28-29. “As shown in Fig. 1B, assume that two BWPs, namely BWP1 and BWP2, are configured for the terminal, wherein BWP1 has a bandwidth of W_1 and BWP2 has a bandwidth of W_2 , a frequency domain displacement $W_{\text{displacement1}}$ is configured for BWP1 and a frequency domain displacement $W_{\text{displacement2}}$ is configured for BWP2.” *Id.*, 7:29-32. “If BWP1 is activated, the terminal determines the position of the second frequency domain resource, which is the frequency domain position of the second hop, $R_2 = (R_1 + W_{\text{displacement1}}) \bmod W_1$, based on $W_{\text{displacement1}}$ and the position of the first frequency domain resource which is the frequency position of the first hop R_1 .” *Id.*, 7:33-35.

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”

157. Shen discloses or renders obvious Claim 3.

158. Shen explicitly discloses that the number of frequency hopping offset values (e.g., $W_{\text{displacement1_1}}$, $W_{\text{displacement1_2}}$) included in the frequency hopping offset set (“frequency domain displacement set”) is determined based on the number of Resource Blocks (“RB”), which are the same as the required “physical resource blocks (PRBs),” constituting the transmission BWP (“separately configured for each of at least one BWP”). Shen’s transmission BWP is “expressed by number of RBs.” EX1013, 5:21-25.

159. Namely, Shen discloses that frequency domain displacement refers to the frequency displacement between two hops in frequency hopping, which can be expressed by number of resources blocks (RBs).” *Id.*, 5:24-25. Shen discloses two BWPs are configured for a terminal: “wherein BWP1 has a bandwidth of W_1 and BWP2 has a bandwidth of W_2 .” *Id.*, 8:3-5. The terminal determines the frequency domain positions based on the configured frequency domain displacements and the size of the activated BWPs. *Id.*, 8:6-19. Thus, “first configuration information is used to indicate at least one frequency domain displacement separately configured for

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each of at least one BWP.” *Id.*, 20-22. “This helps achieve the configuration of different frequency domain displacement sets for different BWPs and full utilization of the bandwidth of each BWP, enabling maximization of frequency hopping without exceeding the bandwidth of the BWP...” *Id.*, 8:22-24.

160. A POSITA would understand by disclosing configuring frequency domain displacements for each BWP based on the bandwidth of the activated BWP, Shen discloses this limitation. This is because, as described in the '460 Patent, a POSITA would understand that BWP is expressed in physical resource blocks (PRBs). By determining the frequency domain displacement (frequency hopping offset values) based on the bandwidth of the activated BWP “without exceeding the bandwidth of the BWP,” (EX1013, 8:23-25), Shen discloses “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.”

161. Further, a POSITA would understand the activated BWP disclosed by Shen refers to the transmission BWP: “the terminal can determine the position of the first frequency domain resource of the physical channel to be transmitted in the activated BWP.” EX1013, 10:10-14.

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162. Thus, Shen teaches a number of frequency hopping offset values is determined based on a number of physical resource blocks (PRBs) constituting the transmission BWP,” to the same extent as the ’460 Patent. EX1001, 13:1-4 (“The number of frequency hopping offset values included in the frequency hopping offset set may be determined on the basis of number of PRBs constituting the transmission BWP.”).

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:”

163. To the extent the preamble is limiting, Shen discloses the preamble of Claim 5 which merely recites a base station (BS) method that complements the UE method of Claim 1.

164. Shen discloses or renders obvious all of the limitations of Claim 5 (directed to “method for a BS”) for at least the reasons discussed above for Claim 1 (directed to “method for a UE”). §XIII.A.1.

165. Because Claim 5 recites the complementary BS elements of the Claim 1 UE, and because Shen discloses a BS/UE uplink (UL) data/control transmission, Claim 5 is anticipated for similar reasons as Claim 1. EX1001, 19:51-20:9.

166. Shen discloses complementary BS/UE uplink data transmission and control transmission. EX1013, 5:19-28.

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;”

167. Element [5.1] recites that bandwidth part (BWP) configuration information is “transmitted”—reflecting that Claim 5 is directed to a method for a BS. EX1013, 6:4-5 (“the network device may further *transmit* a second configuration information to the terminal to be used to indicate the configuration of the at least one BWP.”).

168. Shen teaches that this information is transmitted by a BS, thus satisfying Element [5.1]. §XIII.A.1.a.

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”

169. Element [5.2] recites that frequency hopping configuration information is “transmitted”—reflecting that Claim 5 is directed to a method for a BS. EX1013, 5:21-23 (“the network device *transmits* a first configuration information of a transmission physical channel to the terminal, wherein the first configuration information is used to indicate at least one frequency domain displacement separately configured for each of at least one BWP.”).

170. Shen teaches that this information is transmitted by a BS, thus satisfying Element [5.2]. §XIII.A.1.b.

- 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,”**

171. In Element [5.3], a BS receives the UL control channel and the UL data channel from the UE transmitted by a UE through the reception BWP based on the BWP configuration information and the frequency hopping configuration information (*see* Element [1.3] of Claim 1). A POSITA would understand that Shen’s UE transmits the physical channel to be received by the network device or base station. EX1013, 10:26-27 (“thus, the terminal may transmit the physical channel to the network device”).

172. Shen teaches that this information is received by the BS, thus satisfying Element [5.3]. §XIII.A.1.c.

- 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”**

173. Shen discloses or renders obvious Element [5.4] for at least the reasons discussed with respect to Element [1.4]. §XIII.A.1.d.

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- 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).”**

174. Shen discloses or renders obvious Element [5.5] for at least the reasons discussed with respect to Element [1.5]. §XIII.A.1.e.

- 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.”**

175. Shen discloses Claim 7 for at least the reasons discussed for Claim 3.
§XIII.A.2.

- 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:”**

176. To the extent the preamble is limiting, Shen discloses the preamble of Claim 9.

177. Shen discloses all of the limitations of Claim 9 (directed to “UE”) for at least the reasons discussed above for Claim 1 (directed to “method for a user equipment”). §XIII.A.1.

178. For the reasons discussed above, Shen discloses that the receiver and transmitter are actually configured to (and not merely capable of) performing the

claimed functions at least because the prior art expressly discloses that the receiver and transmitter perform the claimed functions.

179. Thus, Shen discloses “configured to” under any construction. §XI.

- 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”**

180. Element [9.1] recites a receiver of the UE configured to receive, from a BS, the bandwidth part (BWP) configuration information and the frequency hopping configuration information recited in Element [1.1] and Element [1.2], respectively, recited in Claim 1.

181. Further, Shen discloses a “receiver”: “a receiving unit, used to receive a first configuration information of a transmission physical channel transmitted by the network device, wherein the first configuration information is used to indicate at least one frequency domain displacement separately configured for each of at least one BWP.” EX1013, 4:2-4.

182. This teaches a “receiver” to the same extent of the ’460 Patent whose disclosure is limited to: “a UE 1000 includes a receiver 1010, a controller 1020, and a transmitter 1030.” EX1010, 16:60-61.

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183. Element [9.1] is anticipated by Shen which discloses a “terminal” with a “receiving unit” for receiving from a “network device” (BS), the BWP configuration information and the frequency hopping configuration information discussed with respect to Element [1.1] and Element [1.2]. §§XIII.A.1.a, XIII.A.1.b.

- 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,”**

184. 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 in Element [1.3]. §XIII.A.1.c.

185. Further, Shen discloses a “transmitter”: “a transmitting unit 43, which can be used to determine the position of the second frequency domain resource of the physical channel to be transmitted in the activated BWP based on the bandwidth of the activated BWP, the utilized frequency domain displacement, and the position of the first frequency domain resource of the physical channel to be transmitted in the activated BWP.” EX1013, 13:27-34.

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

187. A POSITA would understand that Shen discloses a transmitter as the “terminal may transmit the physical channel to the network device” using the frequency hopping configuration information and the BWP configuration information. EX1013, 10:26-27. This teaches a “transmitter” to the same extent of the ’460 Patent whose disclosure is limited to: “a UE 1000 includes a receiver 1010, a controller 1020, and a transmitter 1030.” EX1001, 16:60-61.

188. A POSITA would thus understand that Shen discloses “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.”

189. Further, Shen teaches Element [9.2] for at least the reasons discussed with respect to Element [1.3]. §XIII.A.1.c.

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- 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”**

190. Shen teaches or renders obvious Element [9.3] for at least the reasons discussed with respect to Element [1.4]. §XIII.A.1.d.

- 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).”**

191. Shen teaches or renders obvious Element [9.4] for at least the reasons discussed with respect to Element [1.5]. §XIII.A.1.e.

- 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.”**

192. Shen discloses Claim 11 for at least the reasons discussed for Claim 3. §XIII.A.2.

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

193. Shen anticipates claims 1, 3, 5, 7, 9, and 11. §XIII.A.1-6.

194. 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

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BWP set” (Elements [1.2], [5.2], and [9.2]), Shen provides this disclosure. §XIII.A.1b.

195. The '460 Patent discloses that the frequency hopping configuration information is transmitted through higher layer signaling (e.g., RRC signaling). EX1001, 15:8-10. Shen discloses that the frequency hopping configuration information is transmitted from the BS to the UE through “high-level signaling or a system broadcast message,” such as “Radio Resource Control (RRC) signaling.” *Id.*, 5:29-37; 6:9-13. *Id.*, 4:14-22; 5:19-31; 6:20-37; Fig. 1A.

196. 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.

197. In addition, a POSITA would have recognized that Shen’s disclosed use of “high-level signaling or a 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 the DCI.

198. 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 PDCCH, which Shen states is one of the “physical channel[s]” configured for each BWP. *Id.*, 5:21-37. The PDCCH, as taught by Shen, is transmitted through the BWP (i.e., inside the BWP frequency range) and is used to transfer the frequency hopping configuration to the UE. *Id.*

199. A POSITA would have had a reasonable expectation of success given that Shen expressly teaches and suggests this technique.

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.”**

200. Claim 2 is unpatentable over Shen and Matsumura.

201. Shen does not explicitly disclose that “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.”

202. However, Matsumura discloses that the frequency hopping configuration information (i.e., “frequency resource information” indicating a frequency offset [EX1019, ¶[0066]]) for a UL control channel (PUCCH) includes at least 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].

203. Matsumura specifically discloses that the frequency resource information (i.e., the frequency hopping configuration information) may include information indicating whether frequency hopping is enabled (turned on or turned off) and an index of a physical resource block (“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]:

Here, *the frequency resource information may also include information indicating the index of a particular frequency resource (such as the first (starting) frequency resource of the first hop) (such as an index of PRB and/or resource element (RE) (PRB/RE)), and information about other frequency resources (such as*

frequency resources after the second hop). The information about the other frequency resource may be, for example, information indicative of a predetermined frequency offset (frequency offset information) or information indicative of the index of the other frequency resource.

Id., [0049].

As shown in Figure 12B, *each PUCCH resource set may include* at least one of the following parameters:

- Information indicating the start symbol of the PUCCH
- Information indicating the number of PUCCH symbols in the slot
- *Information identifying the frequency resource of the first hop of the PUCCH (such as the starting PRB) (such as the index of the starting PRB)*
- Information indicating the *number of resource units (such as the number of PRBs) that make up the frequency resources of the PUCCH*
- *Information indicating whether frequency hopping is applied (enabling) or not (ON or OFF).*
- Information about the frequency resources of the second or subsequent hops when frequency hopping is applied (such as information indicating the frequency offset shown in Figures 4A through 4C, or information

indicating the index of each frequency resource of the second or subsequent hops)

- Information indicating whether intra-slot frequency hopping or inter-slot frequency hopping is applied to the PUSCH that spans multiple slots (information indicating the mode of frequency hopping).

Id., [0097].

204. 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.

205. 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.

206. Such modification would have been a routine addition to Shen's frequency hopping domain offset which is expressed by the number of RBs, which a POSITA would understand to be PRBs. EX1013, 5:24-25.

207. Enhancing Shen's frequency hopping domain offset using Matsumura's indication of whether frequency hopping is enabled and PRB

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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.

208. Such a modification would have been routine, and according to known methods, to obtain predictable results with a reasonable expectation of success.

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.”

209. Claim 6 recites the same limitations as Claim 2 from the perspective of the base station (BS).

210. As discussed for Claim 2, Shen in view of Matsumura teaches the substantive limitations of Claim 6 for at least the reasons discussed for Claim 2.

§XIII.B.1.a.

- 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.”**

211. Claim 10 recites the same limitations as Claim 2 from the perspective of the UE apparatus.

212. As discussed for Claim 2, Shen in view of Matsumura teaches the substantive limitations of Claim 10 for at least the reasons discussed for Claim 2.

§XIII.B.1.a.

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.”**

213. Claim 4 is unpatentable over Shen, Matsumura, and R1-1801080.

214. 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 this feature.

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215. 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.

216. 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.

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217. A POSITA would have understood Matsumura's frequency hopping 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.

218. 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.

219. Enhancing Shen's use of the 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.

220. Such a modification would have been routine, and according to known methods, to obtain predictable results with a high probability of success.

221. In addition, R1-1801080 also discloses the subject matter of Claims 4, 8, and 12, and further demonstrates that the combination of Shen and Matsumura teaches and suggests such subject matter.

222. 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:

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- ***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.

223. 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 by implementing frequency hopping with UE-specific Radio Resource Control (“RRC”) signaling. EX1013, 4:7-13; EX1019, ¶¶[0275-276]; EX1017, §2.3, p.2/33.

224. 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 the objectives of fully utilizing a larger BWP bandwidth to obtain a greater frequency selective gain in Shen and Matsumura.

225. 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 given threshold. Enhancing Matsumura’s predetermined 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.

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226. Such a modification would have been routine, and according to known methods, to obtain predictable results with a high probability of success.

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.”

227. Claim 8 is unpatentable over Shen, Matsumura, and R1-1801080.

228. 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.

229. As discussed for Claim 4, the combination of Shen, Matsumura, and R1-1801080 teaches the substantive limitations of Claim 8 for at least the reasons discussed for Claim 4. §XIII.B.2.a.

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.”

230. Claim 12 is unpatentable over Shen, Matsumura, and R1-1801080.

231. Claim 12 recites the same limitations as Claim 4 from the perspective of the UE apparatus.

232. As discussed for Claim 4, the combination of Shen, Matsumura, and R1-1801080 teaches the substantive limitations of Claim 12 for at least the reasons discussed for Claim 4. §XIII.B.2.a.

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

233. Zhang is a complex and detailed document that anticipates Claims 1-12.

1. Claim 1 (Preamble)

234. Zhang discloses or renders obvious the Preamble. Zhang discloses a method for a UE to transmit an uplink (UL) control channel, such as Zhang's PUCCH, and a UL data channel, such as Zhang's PUSCH, to a BS. EX1020, Abstract, ¶¶[0020-22], [0572], [0550]; Fig. 5:

In one embodiment, an eNB provides Msg3 with multiple possible TBSs for the UE to select, *the UE selects an appropriate TBS value according to the actual data size, and the TBS value used for the actual transmission of Msg3 is transmitted through a PUCCH and is transmitted to the base station* before transmitting Msg3, so the eNB can detect the TBS value used for the actual transmission of Msg3 and decode the Msg3 based on the TBS value, thereby avoiding blind

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decoding on Msg3 based on the hypothesis that there are multiple TBSs. The specific steps of the embodiment are shown in Fig. 26.

Id., [0572].

According to the embodiment of the present application, ***the eMTC UE is scheduled to transmit UL data on an Msg3 PUSCH***, the base station provides multiple possible TBSs in the RAR grant for the UE to select, and the UE will select one TBS value which most closely matches with the data size in the MAC buffer to transmit Msg3, so that the number of the padding bits in the MAC PDU is reduced as much as possible. It is assumed that the base station will perform blindly decoding on the Msg3 based on the multiple possible TBS values. The maximal number of times for blindly decoding is the same as the number of the provided multiple possible TBSs.

Id., [0550].

235. The PUCCH and the PUSCH are recognized “UL control channel” and “UL data channel” in the ’460 Patent’s background section (“In a UL ..., control information is transmitted through a control channel, such as ... a physical uplink control channel (PUCCH)” and UL configured data channel such as “a physical

uplink shared channel (PUSCH), etc., such that data is transmitted”). EX1001, 4:28-34; *see also* EX1019, ¶[0004].

a. Element [1.1]

236. Zhang discloses 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].

237. The UE includes a receiving module configured to receive the BWP resource indication information and the intra-BWP PRB resource indication information transmitted by the base station. *Id.*, ¶¶[0020-21].

238. The BWP resource indication information is used for indicating the BWP resources allocated by the base station to the UE, and the intra-BWP PRB resource indication information is used for indicating the intra-BWP PRB resources allocated by the base station to the UE. *Id.*, ¶¶[0011-12], [0056].

b. Element [1.2]

239. 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

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of the UL control channel, and PRB allocation information of a second frequency resource region of the UL control channel. EX1001, 12:33-39.

240. 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. EX1020, ¶[0224]. Zhang’s UL control/data channels (PUCCH/PUSCH) are transmitted through one transmission BWP (“BWP resource”) of the BWP set. *Id.*, ¶¶[0010-12]; [0020-21].

241. If the UL grant includes indication of frequency hopping, the uplink resource allocation information also includes resource allocation of the corresponding frequency hopping. *Id.* Zhang provides different specific resource allocation solutions, in which each solution supports two different frequency hopping indications, i.e., no frequency hopping and frequency hopping, and also supports three different PRB allocation ways, i.e., continuous allocation of PRBs, discontinuous allocation of PRBs and partially continuous allocation of PRBs. *Id.*

242. If the uplink grant information carries the frequency hopping indication information, 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]. Thus, Zhang discloses

that the frequency hopping configuration information is transmitted through one transmission BWP of the BWP set.

c. Element [1.3]

243. Zhang discloses or renders obvious Element [1.3]. Zhang discloses transmitting, by the UE, of a UL data on a PUSCH and UL control information on a PUCCH based on the BWP configuration information (the BWP resource indication information) and the frequency hopping configuration information (the intra-BWP PRB resource indication information allocated to the UE by the base station). §XIII.C.1.a-b.

244. 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].

d. Element [1.4]

245. Zhang discloses or renders obvious Element [1.4].

246. It is my opinion that Zhang’s intra-BWP Physical Resource Block (PRB) Resource Block Group (“RBG”) offset indication for different BWPs satisfies the claimed “frequency hopping offset set composed of one or more frequency

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hopping offset values.” EX1020, ¶[0172]. Zhang discloses that the 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].

247. Zhang discloses many times, including in the Abstract, that the intra-BWP PRB resources are allocated inside the BWP resource by the base station. In addition, the plain language definition of “intra” means “on the inside” or “within” the main BWP resource and these PRBs are specifically allocated and can be used separately by the UE for transmitting information to the base station. As one of the examples of intra being “within,” Zhang discloses “Further, the intra-BWP PRB resource indication information **indicates the BWP resources within the BWP** which is allocated by the base station to the UE by at least one of the following ways:” EX1020, ¶[0262].

248. Zhang additionally discloses that the 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].

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249. 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.*

250. The base station allocates one or more RBG resources, each including a fixed number of PRBs, within an RBG set to the UE. *Id.*, ¶¶[0453], [0458].

251. In particular, the base station 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].

252. 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.

253. Zhang discloses an efficient method of specifying the specific 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]

254. Using this bit map allocation method, Zhang discloses that the intra-BWP PRB resource allocation information may include a fixed bit of RBG offset indication for different BWPs. *Id.* Thus, Zhang discloses using different BWPs where a frequency hopping offset, from a set of offsets, can be specified for a specific BWP.

e. Element [1.5]

255. Zhang discloses or renders obvious Element [1.5]. Zhang discloses that the 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 and the number of PRBs according to the RIV and a corresponding calculation method for the UL data channel (PUSCH). EX1020, ¶¶[0166-172], [0326-330]:

It is an important step in a radio communication system to ***indicate the UE the resources for uplink transmission through an uplink grant (UL Grant)***. In LTE/LTE-A, ***a specific Downlink Control Information (DCI)*** and a Random Access Response (RAR or Msg2) in the random

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access procedure both *include the UL Grant*. Wherein, *the UL grant contains the following information:*

- frequency hopping flag

- *resource allocation indication, which might include* Resource Indication Value (RIV) and *frequency hopping resource allocation information;*

...

The UE can obtain a starting Physical Resource Block (PRB) location (RBs_{TART}) and the number (Lc_{Rss}) of allocated continuous PRBs according to the RIV and a corresponding calculation method. ...

If the frequency hopping flag is 1, *the resource allocation indication includes both the frequency hopping resource allocation information and the RIV.* ...

Id., ¶¶[0166-172].

When a subsequent base station transmits a Random Access Response (RAR) and when it is necessary to perform uplink scheduling using Downlink Control Information (DCI), *the transmitted UL Grant includes the following information:*

- BWP resource indication information

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- intra-BWP PRB resource indication information
- other information

... when there is a frequency hopping indication in the UL Grant, the BWP resource indication information can include both frequency hopping indication information and BWP resource information used for UE uplink data transmission. The intra-BWP PRB resource indication information can include both frequency hopping indication information and activated uplink intra-BWP PRB resource information used for transmission.

Id., ¶¶[0326-330].

2. Claim 2

256. Zhang discloses or renders obvious Claim 2. Zhang discloses that the frequency hopping configuration information for a UL control channel includes at least one of 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

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allocation of PRBs, discontinuous allocation of PRBs, and partially continuous allocation of PRBs. EX1020, ¶[0224]:

For the future radio communication system, an embodiment of the present disclosure proposes a new method for uplink resource allocation. In this method, the UL Grant is still used for uplink resource allocation, wherein the uplink resource allocation information includes at least two parts of indication information: one part indicates the information of the BWP and the other indicates the information of PRB within the BWP. *If the UL Grant further includes indication of frequency hopping, the uplink resource allocation information should also include resource allocation of the corresponding frequency hopping.* Specifically, for the foregoing two part of the indication information, the embodiments of the present disclosure provide different specific resource allocation solutions, in which each solution supports two different frequency hopping indications, i.e. *no frequency hopping and frequency hopping*, and also supports *three different PRB allocation ways, i.e. continuous allocation of PRBs, discontinuous allocation of PRBs and partially continuous allocation of PRBs.*

3. Claim 3

257. Zhang discloses or renders obvious Claim 3. Zhang discloses that the 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].

4. Claim 4

258. Zhang discloses or renders obvious Claim 4. Zhang discloses that the 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 bandwidth of the BWP, where the uplink resources allocated by the base station to the UE are located, is L_{UL} PRBs, and indexes of the L_{UL} PRBs are $0, 1, \dots, L_{UL}-1$ in order. EX1020, ¶[0453].

259. According to the size of the BWP bandwidth, Zhang's system defines a concept of resource block group ("RBG"), wherein each RBG consists of a fixed number of P 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. *Id.* The base station allocates the uplink transmission resources in units of PRB. *Id.*

5. Claims 5-8 and 9-12

260. Claims 5-8 recite the same elements as Claims 1-4 from the base station (BS) perspective. EX1001, 19:51-20:9.

261. Zhang renders these claims unpatentable because Zhang discloses complementary BS/UE uplink data transmission and control transmission. EX1020, Abstract, ¶¶[0020-22], [0136], [0509], [0572].

262. Claims 9-12 are user equipment (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.

263. Zhang teaches all of the limitations of Claims 5-8 and 9-12 for at least the reasons discussed above for Claims 1-4, respectively. §XIII.C.1-4.

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

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

265. To the extent there are any minor differences between Zhang and the features of the Challenged Claims, any such minor differences would have been obvious to a POSITA.

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266. In addition, to the extent any expert testimony is interpretive of Zhang, it is my opinion that any minor differences would have been obvious to a POSITA to be taught by Zhang.

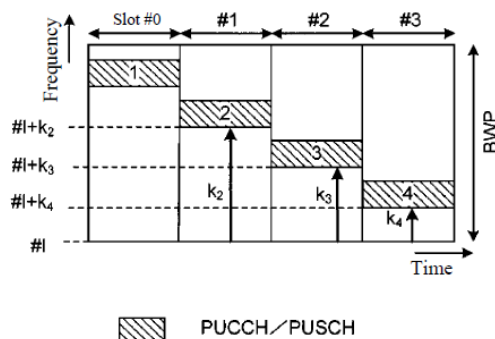
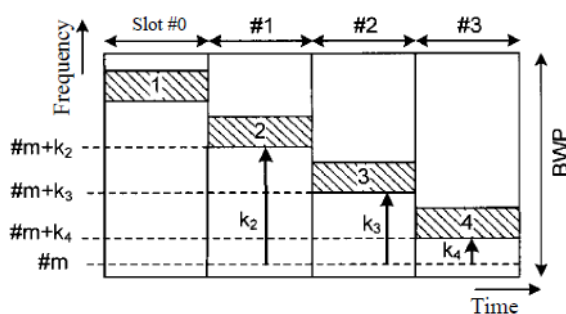
267. Thus, it is my opinion that the Challenged Claims are obvious over Zhang.

268. 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].

269. Matsumura discloses in Figs. 7A and 7B (reproduced below) multiple frequency offset values k_2 , k_3 , k_4 notified from the base station to the UE, so that the user terminal can appropriately control a frequency hopping pattern based on the frequency resource information. *Id.*, ¶[0060].

FIGURE 7B

FIGURE 7A



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270. A POSITA would have been motivated to combine Matsumura's frequency offset values k_2 , k_3 , k_4 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].

271. Such a modification would have been routine, and according to known methods, to obtain predictable results with a high probability of success.

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

272. 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. §XIII.B.3.

273. 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." §XIII.B.3.

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 by implementing frequency hopping with UE-specific Radio Resource Control

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(“RRC”) signaling. EX1020, ¶¶[0163-169], [0174-175], [0488-490]; [0521-522]; EX1019, ¶¶[0275-276]; EX1017, §2.3, p.2/33.

275. Similar to R1-1801080, Zhang’s and Matsumura’s systems define the size of the bandwidth part (“BWP”) as a concept of Resource Blocks (“RB”) or resource block group (“RBG”), in which each RBG consists of a fixed number of P 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, ¶[0457]; EX1019, ¶[0098].

276. The base station allocates the uplink transmission resources in units of PRBs. EX1020, ¶[0457].

277. 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].

278. 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.

279. 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

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PRBs in the RBG at the edge of the BWP of Zhang and Matsumura's predetermined threshold. Enhancing Matsumura's predetermined 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.

280. Such a modification would have been routine, and according to known methods, to obtain predictable results with a high probability of success.

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)

281. 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 information that is transmitted on a PUSCH: 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.

282. For the reasons outlined below, it is my opinion that 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.

1. Claim 1 (Preamble)

283. Yin discloses the Preamble.

284. Yin discloses a method for uplink transmission, by a user equipment (UE 101, Fig. 1) to a base station (gNB), of uplink control information (UCI) or data using one or more uplink channels, such as Yin's Physical Uplink Control Channel ("PUCCH") and a Physical Uplink Shared Channel ("PUSCH"). EX1021, ¶¶[0053], [0058], [0063]; EX1022, ¶¶[0045], [0050], [0056]. For example, "a UE 102 may *transmit* information or data to the gNB 160 using one or more uplink channels 121. Examples of uplink channels 121 include a PUCCH and a PUSCH. EX1021, ¶[0058]; EX1022, ¶¶[0050]. A POSITA would understand that PUSCH represents the uplink (UL) data channel and PUCCH represents the uplink (UL) control channel.

a. Element [1.1]

285. Yin discloses Element [1.1].

286. 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

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for the UE 102. EX1021, ¶¶[0052], [0054], [0085]; EX1022, ¶¶[0044], [0046], [0077].

287. A POSITA would understand that the subbands described in Yin refer to the BWPs described by the '460 Patent. For example, Yin discloses “[t]o provide frequency diversity, separate PUCCH regions or subbands should be configured for a UE 102, and the PUCCH can be transmitted simultaneously in both regions/subbands.” EX1021, ¶[0085]. The '460 Patent similar describes that BWPs are configured for a UE. EX1001, 13:37-39, 15:21-22. Further, BWPs are expressed as physical resource blocks (PRBs) in the '460 Patent. EX1001, 13:1-4. Similarly, Yin discloses that the PUCCH region/subband should be expressed as RBs: “the following parameters should be specified: the number of RBs in a PUCCH region/subband.” EX1021, ¶[0095]. Thus, a POSITA would understand that the subbands of in refer to the BWPs described by the '460 Patent.

288. 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 base station.*** EX1021, ¶¶[0053-55]; EX1022, ¶¶[0045-47].

289. Yin discloses numerous times that “separate PUCCH regions or subbands should be configured for the UE 102, and the PUCCH can be transmitted

simultaneously in both regions/subbands.” *See e.g.*, EX1021 ¶[0077]. Yin further discloses that frequency hopping can be configured for both of these regions or subbands. EX1021 ¶[0094] “To provide frequency diversity, frequency hopping of a 2-symbol short PUCCH can be configured. In this case, separate PUCCH regions or subbands should be configured for a UE 102, and the PUCCH can be transmitted simultaneously in both regions/subbands.”

290. Yin also discloses that a specific number of RBs are assigned to each PUCCH region/subband, which is defining different BWPs. EX1021 ¶[0078] “one or more of the following parameters should be specified: the number of RBs in a PUCCH region/subband.”

291. 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].

b. Element [1.2]

292. Yin discloses Element [1.2]. Yin 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

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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.

293. The 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 resource blocks (RBs) and/or one or more control resource regions (i.e., frequency hopping configuration information). EX1021, ¶¶[0042], [0213]; EX1022, ¶¶[0034], [0199].

294. 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].

295. However, TS 36.211 and TS 36.213 describe a base station configuring frequency hopping for the PUSCH. EX1024, §5.3.4, p.22; EX1025, §8.4, pp.114-115.

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296. 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.

297. 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.

298. 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].

299. 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].

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300. This integration allows 5G NR-only capabilities (e.g., BWPs) to be implemented, when possible, while retaining backwards-compatible methods for 4G LTE.

301. Such a modification would have been routine, and according to known methods, to obtain predictable results with a high probability of success.

c. Element [1.3]

302. Yin discloses Element [1.3]. Yin discloses transmitting a UL control channel, represented by Yin's UL control information (UCI), to the base station, through the transmission BWP (designated in Yin as the "PUCCH resource corresponding to the PUCCH resource configuration within the selected set of PUCCH resource configurations") based on the BWP configuration information, such as the 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.

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303. 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.

304. 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.

305. 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. §XIII.E.1.c; EX1021, ¶¶[0004-0005], [0053-55]; EX1022, ¶¶[0003-0004], [0045-47].

306. Such a modification would have been routine, and according to known methods, to obtain predictable results with a high probability of success.

d. Element [1.4]

307. Yin discloses that the UE receives from the BS frequency hopping configuration information. §XIII.E.1.b.

308. 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.

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309. However, TS 36.213 describes frequency hopping for the PUSCH and multiple hopping types (set of offsets). In particular, a UE performing PUSCH frequency hopping uses one of two possible PUSCH frequency hopping types--PUSCH hopping type 1 (Section 8.4.1) and type 2 (Section 8.4.2)--based on the hopping information. For this element, I am using PUSCH hopping Type 1. EX1025, pp.114-115.

A UE performing PUSCH frequency hopping shall use one of two possible PUSCH frequency hopping types based on the hopping information. PUSCH hopping type 1 is described in subclause 8.4.1 and type 2 is described in subclause 8.4.2.

Table 8.4-1: Number of Hopping Bits N_{UL_hop} vs. System Bandwidth

System BW N_{RB}^{UL}	#Hopping bits for 2nd slot RA (N_{UL_hop})
6-49	1
50-110	2

The parameter *Hopping-mode* provided by higher layers determines if PUSCH frequency hopping is "inter-subframe" or "intra and inter-subframe".

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

310. For example, if the system bandwidth (BW) shown in Table 8.4.2 above is between 50-110 uplink resource blocks, based on the number of system BW blocks, the UE uses at least one of the three different frequency hopping offset values “00”, “01”, “10” for Type 1 frequency hopping as specified by the base station 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.*

311. 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 RBs to use when the “information in hopping bits” is set to “10” by the base station. EX1025, §8.4.1, ll.1-5, p.115.

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312. The answer in the above calculation is based on six uplink RBs being allocated for the PUCCH, so the remaining available hopping bandwidth for the PUSCH will be 44 RBs. The equation for the “10” value above divides these 44 RBs by 2, which is the value of 22 RBs for the initial hopping offset value. Further for this example, if the UE is using PRBs 3 and 4 before the first frequency hop, its first hop will be by a frequency offset of 22 RBs so it would then use the 25th and 26th RBs.³

³ The equation for the “10” value in the table above performs the following steps: (1) I selected 50 for the total number of uplink PRBs that would typically be used for a 10 MHz bandwidth; (2) because the PUCCH uses some of these, I subtracted 6 from this total, leaving 44 uplink PRBs available for the PUSCH; (3) The left hand side of the equation divides the total number of RBs available for the PUSCH by 2; (4) The vertical lines with a small horizontal line at the bottom represent a mathematical floor function that essentially rounds the resulting quotient down to the nearest integer. Because my example uses $44/2=22$, the floor function did not reduce the quotient; (5) the resulting value of 22 is then added to the first PRB number currently being used by the UE. I used a first PRB value of 3 and a length of 2 PRBs so the UE would be using PRBs 3 and 4 before the hop. Thus, after the

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313. TS 36.213 describes a DCI format 0 (DCI 0) message that is transmitted from the base station and is used to configure frequency hopping for the PUSCH:

frequency hop of 22 PRBs, the resulting PRBs the UE would be using are numbers 25 and 26; and (6) the “mod” function on the right side of the equation applies a modulo value using the total number of PUSCH RBs (44 in my example), which ensures the hop stays within the allocated PUSCH PRB space, which was not applied in my example.

8.4 UE PUSCH hopping procedure

The UE shall perform PUSCH frequency hopping if the single bit Frequency Hopping (FH) field in a corresponding PDCCH/EPDCCH with DCI format 0 is set to 1 and the uplink resource block assignment is type 0 otherwise no PUSCH frequency hopping is performed.

A UE performing PUSCH frequency hopping shall determine its PUSCH Resource Allocation (RA) for the first slot of a subframe (SI) including the lowest index PRB ($n_{PRB}^{SI}(n)$) in subframe n from the resource allocation field in the latest PDCCH/EPDCCH with DCI format 0 for the same transport block. If there is no PDCCH/EPDCCH for the same transport block, the UE shall determine its hopping type based on

- the hopping information in the most recent semi-persistent scheduling assignment PDCCH/EPDCCH, when the initial PUSCH for the same transport block is semi-persistently scheduled or
- the random access response grant for the same transport block, when the PUSCH is initiated by the random access response grant.

The resource allocation field in DCI format 0 excludes either 1 or 2 bits used for hopping information as indicated by Table 8.4-1 below where the number of PUSCH resource blocks is defined as

$$N_{RB}^{PUSCH} = \begin{cases} N_{RB}^{UL} - \tilde{N}_{RB}^{HO} - (N_{RB}^{UL} \bmod 2) & \text{Type 1 PUSCH hopping} \\ N_{RB}^{UL} & \text{Type 2 } N_{sb} = 1 \text{ PUSCH hopping} \\ N_{RB}^{UL} - \tilde{N}_{RB}^{HO} & \text{Type 2 } N_{sb} > 1 \text{ PUSCH hopping} \end{cases}$$

For type 1 and type 2 PUSCH hopping, $\tilde{N}_{RB}^{HO} = N_{RB}^{HO} + 1$ if N_{RB}^{HO} is an odd number where N_{RB}^{HO} defined in [3]. $\tilde{N}_{RB}^{HO} = N_{RB}^{HO}$ in other cases. The size of the resource allocation field in DCI format 0 after excluding either 1 or 2 bits shall be $y = \lceil \log_2 (N_{RB}^{UL} (N_{RB}^{UL} + 1) / 2) \rceil - N_{UL_hop}$, where $N_{UL_hop} = 1$ or 2 bits. The number of contiguous RBs that can be assigned to a type-1 hopping user is limited to $\lfloor 2^y / N_{RB}^{UL} \rfloor$. The number of contiguous RBs that can be assigned to a type-2 hopping user is limited to $\min(\lfloor 2^y / N_{RB}^{UL} \rfloor, \lfloor N_{RB}^{PUSCH} / N_{sb} \rfloor)$, where the number of sub-bands N_{sb} is given by higher layers.

EX1025, Section 8.4, p.114.

314. The RRC signaling protocol message in DCI format 0 (DCI 0) that is sent from the base station to the UE in the disclosure reproduced above indicates multiple hopping parameters: (1) PUSCH frequency hopping is to be performed; and (2) for Type 1 frequency hopping, the base station specifies the frequency offset to

be used for the first hop that is from a set of three different hops. EX1025, §8.4, p.114.

315. A POSITA would have had reason to combine the PUSCH frequency hopping offset set composed of one or more frequency hopping offset values described in TS 36.213 with the PUCCH frequency hopping offset set composed of one or more frequency hopping offset values 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. §XIII.E.1.c; EX1021, ¶¶[0004-0005], [0053-55]; EX1022, ¶¶[0003-0004], [0045-47].

316. Such a modification would have been routine, and according to known methods, to obtain predictable results with a high probability of success.

e. Element [1.5]

317. 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].

318. 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.

319. 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:

8.4.1 Type 1 PUSCH hopping

For PUSCH hopping type 1 the hopping bit or bits indicated in Table 8.4-1 determine $\tilde{n}_{PRB}(i)$ as defined in Table 8.4-2. The lowest index PRB ($n_{PRB}^{S1}(i)$) of the 1st slot RA in subframe i is defined as $n_{PRB}^{S1}(i) = \tilde{n}_{PRB}(i) + \tilde{N}_{RB}^{HO} / 2$, where $n_{PRB}^{S1}(i) = RB_{START}$, and RB_{START} is obtained from the **uplink scheduling grant** as in subclause 8.4 and subclause 8.1.

The lowest index PRB ($n_{PRB}(i)$) of the 2nd slot RA in subframe i is defined as $n_{PRB}(i) = \tilde{n}_{PRB}(i) + \tilde{N}_{RB}^{HO} / 2$.

The set of physical resource blocks to be used for PUSCH transmission are L_{CRBs} contiguously allocated resource blocks from PRB index $n_{PRB}^{S1}(i)$ for the 1st slot, and from PRB index $n_{PRB}(i)$ for the 2nd slot, respectively, where L_{CRBs} is obtained from the **uplink scheduling grant** as in subclause 8.4 and subclause 8.1.

If the *Hopping-mode* is "inter-subframe", the 1st slot RA is applied to even CURRENT_TX_NB, and the 2nd slot RA is applied to odd CURRENT_TX_NB, where CURRENT_TX_NB is defined in [8].

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].

EX1025, p.115.

320. A POSITA would have had reason to combine the PUSCH UL grant DCI message described in TS 36.213 with the PUCCH UL grant DCI message 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. §XIII.E.1.c; EX1021, ¶¶[0004-0005], [0053-55]; EX1021, ¶¶[0003-0004], [0045-47].

321. Such a modification would have been routine, and according to known methods, to obtain predictable results with a high probability of success.

2. Claim 2

322. Yin discloses Claim 2.

323. Yin discloses that the frequency hopping configuration information, such as a discrete Fourier transform spread OFDM (DFT-S-OFDM) waveform or a CP-OFDM waveform, for a UL control channel (PUCCH) includes information indicating physical resource block (PRB) allocation information, 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].

324. 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.*

3. Claim 3

325. Yin discloses Claim 3. Yin discloses that the number of frequency hopping offset values included in the frequency hopping offset set, such as a 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].

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326. An uplink radio frame may consist of multiple pairs of uplink resource blocks. *Id.*

327. The uplink RB pair is a unit for assigning uplink radio resources, defined by a predetermined bandwidth (RB bandwidth). *Id.*

328. The uplink RB may consist of twelve sub-carriers in frequency domain and seven (for normal CP) or six (for extended CP) OFDM/DFT-S-OFDM symbols in time domain. EX1021, ¶[0168]; EX1022, ¶[0160].

329. Yin specifically 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].

330. Yin does not explicitly disclose that the frequency hopping offset for the PUSCH includes a frequency hopping offset set is determined based on the number of RBs.

331. However, TS 36.211 describes that the offset used for PUSCH frequency hopping is expressed in the number of RBs set by higher layers:

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N_{RB}^{HO}	The offset used for PUSCH frequency hopping, expressed in number of resource blocks (set by higher layers)
N_{ID}^{cell}	Physical layer cell identity
N_{ID}^{MBSFN}	MBSFN area identity
N_{RB}^{DL}	Downlink bandwidth configuration, expressed in multiples of N_{sc}^{RB}
$N_{RB}^{min, DL}$	Smallest downlink bandwidth configuration, expressed in multiples of N_{sc}^{RB}
$N_{RB}^{max, DL}$	Largest downlink bandwidth configuration, expressed in multiples of N_{sc}^{RB}
N_{RB}^{UL}	Uplink bandwidth configuration, expressed in multiples of N_{sc}^{RB}
$N_{RB}^{min, UL}$	Smallest uplink bandwidth configuration, expressed in multiples of N_{sc}^{RB}
$N_{RB}^{max, UL}$	Largest uplink bandwidth configuration, expressed in multiples of N_{sc}^{RB}
N_{symb}^{DL}	Number of OFDM symbols in a downlink slot
N_{symb}^{UL}	Number of SC-FDMA symbols in an uplink slot
N_{sc}^{RB}	Resource block size in the frequency domain, expressed as a number of subcarriers
N_{sb}	Number of sub-bands for PUSCH frequency-hopping with predefined hopping pattern
N_{RB}^{sb}	Size of each sub-band for PUSCH frequency-hopping with predefined hopping pattern, expressed as a number of resource blocks

EX1024, p.8.

332. A POSITA would have been motivated to combine the PUSCH offset expressed in the number of RBs described in TS 36.211 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. §XIII.E.1.c; EX1021, ¶¶[0004-0005], [0053-55]; EX1022, ¶¶[0003-0004], [0045-47].

333. Such a modification would have been routine, and according to known methods, to obtain predictable results with a high probability of success.

4. Claim 4

334. 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.

335. 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; §XIII.E.1.d. For example, 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).

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

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336. 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.

337. As further evidenced by Jersenius (Ground 6) a PUSCH bandwidth including less than 50 Physical Resource Blocks (PRB) was known in the prior art. EX1023, ¶[0047].

5. Claims 5-8 and 9-12

338. Claims 5-8 recite the same elements as Claims 1-4, respectively, from the perspective of the base station (“BS”). EX1001, 19:51-20:9.

339. Claims 9-12 are user equipment claims that recite the same elements as Claims 1-4, respectively. EX1001, 19:51-20:9.

340. Yin renders these claims unpatentable because Yin discloses complementary BS/UE uplink data transmission and control transmission. EX1021, ¶¶[0053], [0058], [0063]; EX1022, ¶¶[0045], [0050], [0056].

341. Yin, TS 36.211, and TS 36.213 teach all of the limitations of Claims 5-8 and 9-12 for at least the reasons discussed above for Claims 1-4, respectively. §VII.E.1-4.

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

342. Claims 4, 8, and 12 would have been obvious over Yin, TS 36.211, and TS 36.213. §XIII.E.

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343. To the extent clarification is warranted of the TS 36.213 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 Physical Resource Blocks (PRB). EX1023, ¶[0047].

344. Jersenius discloses that the frequency hopping value is set to $BW/2$ when the available bandwidth is less than 50 PRBs. *Id.*

345. The '460 Patent discloses the same value for the number of PRBs. EX1001, 13:5-21.

346. Yin and Jersenius seek to improve the transmission performance of the physical uplink channel and the accuracy in UE resource allocation in 5G communication systems. *See* EX1021, ¶¶[0003-0005]; EX1023, ¶[0015]. Yin and Jersenius improve the transmission performance and the accuracy in UE resource allocation by implementing intra-subframe hopping with Radio Resource Control (“RRC”) signaling dedicated to a UE or a Downlink Control Information (DCI) message. *See* EX1021, ¶¶[0065], [0124], [0161], [0166]; EX1023, ¶[0040].

347. Similar to Jersenius, Yin’s system defines the size of the subband as a concept of Resource Blocks (“RBs”). EX1021, ¶¶[0095], [0183]; EX1022, ¶[0173]; EX1023, ¶[0051]. The base station allocates the uplink transmission resources in units of PRB. *Id.*

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348. Yin explicitly discloses that UL control channels with a short format may be mapped on resource elements (REs) within multiple PRBs. EX1021, ¶[0183]; EX1022, ¶[0173]. For example, the UL control channel may be mapped to every N PRBs (*e.g.*, 5 or 10) within a system bandwidth. *Id.*

349. 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]; EX1022, ¶¶[0002-0004], [0045], [0079], [0107]; EX1023, ¶¶[0015], [0040].

350. A POSITA would have understood Jersenius' method confirming the 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 enhanced UE resource allocation disclosed in Yin.

351. 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 the number of N PRBs (*e.g.*, 5 or 10) within Yin's system bandwidth.

352. 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 and Jersenius.

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353. Such a modification would have been routine, and according to known methods, to obtain predictable results with a reasonable expectation of success.

XIV. SECONDARY CONSIDERATIONS

354. As discussed herein, all elements of the Challenged Claims were known in the art, and any differences would have been obvious to a POSITA based on the disclosures of the applied references and the knowledge in the art.

355. I am not aware of any secondary considerations that would alter my opinion. For instance, there was no long felt need as multiple different databases and calibration data used for determining locations of wireless device were known and used before the effective filing date of the '460 Patent.

356. Any secondary considerations evidence Patent Owner may offer in this proceeding would be insufficient to overcome the strong evidence that the Challenged Claims are obvious.

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XV. CONCLUSION

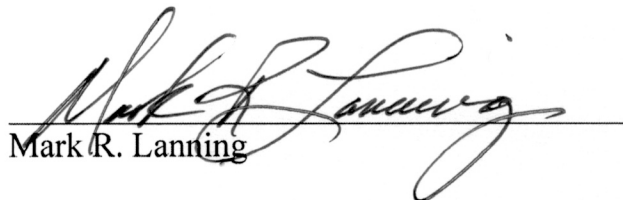
357. For the reasons set forth above, it is my opinion that all elements of the Challenged Claims of the '460 Patent are disclosed or suggested by the prior art. In my opinion, the Challenged Claims of the '460 Patent would have been obvious over the prior art.

358. In signing this Declaration, I understand that the Declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I acknowledge that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

359. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Date:

12/24/2024


Mark R. Lanning