

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

Petitioners,

v.

APEX BEAM TECHNOLOGIES LLC,

Patent Owner.

Patent No. 10,462,767
Filing Date: April 18, 2018
Issue Date: October 29, 2019

Inventor: Xiaobo Zhang
Title: METHOD AND DEVICE IN UE AND BASE STATION
USED FOR PAGING

PATENT OWNER'S RESPONSE

Case No. IPR2023-00598

TABLE OF CONTENTS

	<u>Page(s)</u>
I. INTRODUCTION	1
II. THE '767 PATENT	3
III. THE ALLEGED PRIOR ART	4
A. WO 2017/052199 (“You”)	4
B. WO 2018/126401 (“Liu”)	6
C. WO 2016/136143 (“Mallick”)	7
IV. CLAIM CONSTRUCTION	8
V. LEVEL OF ORDINARY SKILL IN THE ART	12
VI. REQUIREMENTS UNDER 35 U.S.C. § 103	12
VII. PETITIONER HAS NOT PROVED INVALIDITY OF THE CHALLENGED CLAIMS BY A PREPONDERANCE OF THE EVIDENCE	14
A. There is No Motivation to Combine the 4G / LTE Systems of You or Mallick with the 5G / NR System of Liu	14
B. Ground 1: The Combination of You and Liu Does Not Render Claims 1 and 4-6 Obvious	19
1. The Combination of You and Liu Does Not Render Obvious “ <i>monitoring a first signaling in X time intervals,</i> ” as Required by Claim 1	19
2. The Combination of You and Liu Does Not Render Obvious “ <i>wherein X is a positive integer,</i> ” as Required by Claim 1	22
3. The Combination of You and Liu Does Not Render Obvious “ <i>the first signaling is used for determining scheduling information for the first radio signal</i> ” as Required by Claim 1	23

4.	The Combination of You and Liu Does Not Render Obvious “ <i>the scheduling information comprises at least one of {occupied time-frequency resource, adopted Modulation Coding Scheme (MCS), subcarrier spacing of subcarriers in occupied frequency domain resource}</i> ” as Required by Claim 1	24
5.	The Combination of You and Liu Does Not Render Obvious “ <i>the frequency domain resource used for transmitting the first signaling belongs to a first subband</i> ” as Required by Claim 1	24
6.	The Combination of You and Liu Does Not Render Obvious “ <i>at least one of {location of the first subband in frequency domain, subcarrier spacing of subcarriers included in the first subband} is used for determining the X time intervals,</i> ” as Required by Claim 1.....	26
7.	The Combination of You and Liu Does Not Render Obvious “ <i>receiving a second radio signal wherein the second radio signal is used for determining at least one of {location of the first subband in frequency domain, subcarrier spacing of subcarriers included in the first subband},</i> ” as Required by Claim 4.....	28
8.	The Combination of You and Liu Does Not Render Obvious “ <i>the first subband belongs to one of the Q subbands,</i> ” as Required by Claim 5	29
9.	The Combination of You and Liu Does Not Render Obvious “ <i>the feature ID of the monitor of the first signaling is used for determining the first subband in the Q subbands,</i> ” as Required by Claim 5	30
C.	Ground 2: The Combination of You, Liu, and Mallick Does Not Render Claims 2 and 3 Obvious.....	31
1.	The Combination of You, Liu, and Mallick Does Not Render Obvious “ <i>wherein any one of the X time intervals belongs to a first time window in time domain,</i> ” as Required by Claim 2	31

2.	The Combination of You, Liu, and Mallick Does Not Render Obvious “ <i>the first time window is divided into Y time intervals,</i> ” as Required by Claim 2	32
3.	The Combination of You, Liu, and Mallick Does Not Render Obvious “ <i>the X time intervals are X time intervals of the Y time intervals, Y being a positive integer not smaller than X,</i> ” as Required by Claim 2	33
4.	The Combination of You, Liu, and Mallick Does Not Render Obvious “ <i>the subcarrier spacing of subcarriers included in the first subband is used for determining Y,</i> ” as Required by Claim 2	33
5.	The Combination of You, Liu, and Mallick Does Not Render Obvious “ <i>a feature ID of a monitor of the first signaling is used for determining the X time intervals in the Y time intervals,</i> ” as Required by Claim 2	34
6.	The Combination of You, Liu, and Mallick Does Not Render Obvious “ <i>the feature ID of the monitor of the first signaling is used for determining the first time window in the Z time windows,</i> ” as Required by Claim 3	35
D.	Any Combination of You, Liu, and Mallick Does Not Render Claims 2-20 Obvious	35
VIII.	CONCLUSION	36

TABLE OF AUTHORITIES

	Page(s)
Cases	
<i>Apple, Inc. v. Contentguard Holdings, Inc.</i> , IPR2015-00355, Paper 9 (P.T.A.B. June 26, 2015)	12
<i>Broadcom Corp. v. Emulex Corp.</i> , 732 F.3d 1325 (Fed. Cir. 2013)	14
<i>Graham v. John Deere Co. of Kansas City</i> , 383 U.S. 1 (1966).....	12
<i>Innogenetics, N.V. v. Abbott Lab 'ys.</i> , 512 F.3d 1363 (Fed. Cir. 2008)	14
<i>Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.</i> , 821 F.3d 1359 (Fed. Cir. 2016)	13
<i>Los Angeles Biomedical Rsch. Inst. at Harbor-UCLA Med. Ctr. v. Eli Lilly Co.</i> , 849 F.3d 1049 (Fed. Cir. 2017)	13
<i>Pers. Web Techs., LLC v. Apple, Inc.</i> , 848 F.3d 987 (Fed. Cir. 2017)	13
<i>Realtime Data, LLC v. Iancu</i> , 912 F.3d 1368 (Fed. Cir. 2019)	9
Statutes	
35 U.S.C. § 103	12

EXHIBIT LIST

Exhibit No.	Description of Document
2001	Samsung's Invalidity Contentions for U.S. Patent No. 10,462,767, <i>Apex Beam Techs. LLC v. Samsung Elecs. Co., Ltd., et al.</i> , Case No. 2:22-cv-00188-JRG, served March 2, 2023.
2002	Docket Control Order, Dkt. 37, <i>Apex Beam Technologies LLC v. Samsung Electronics Co., Ltd., et al.</i> , Case No. 2:22-cv-00188-JRG (E.D. Tex. Feb. 6, 2023).
2003	Order, Dkt. 55, <i>Apex Beam Techs. LLC v. ZTE Corp.</i> , Case No. 2:22-cv-00031-JRG (E.D. Tex. June 14, 2023)
2004	Declaration of Miguel Gomez ("Gomez Decl."), dated December 7, 2023 and Exhibit A, Curriculum Vitae of Miguel Gomez.
2005	Deposition of Harry Bims, taken in <i>Samsung Elecs. Co., v. Apex Beam Techs. LLC</i> , IPR2023-00598 on November 21, 2023. ("Bims Depo.")
2006	Defendants' Patent Local Rule 4-2 Disclosure of Preliminary Claim Constructions and Extrinsic Evidence, <i>Apex Beam Techs. LLC v. Samsung Elecs. Co.</i> , Case No. 2:22-cv-00188-JRG (E.D. Tex. Sept. 1, 2023).

I. INTRODUCTION

The Board should issue a Final Written Decision finding all of the Challenged Claims of the U.S. Patent No. 10,462,767 (Ex. 1001, the “’767 Patent”) not unpatentable because Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. (collectively, “Petitioner” or “Samsung”) fail to show that the combination of International Patent Publication No. 2017/052199 to You *et al.*, filed September 21, 2016, and published March 30, 2017 (“You”), International Patent Publication No. 2018/126401 to Liu *et al.*, filed January 5, 2017, and published July 12, 2018 (“Liu”), and International Patent Publication No. 2016/136143 to Mallick *et al.*, filed January 28, 2016, and published September 1, 2016 (“Mallick”) discloses or render obvious the inventions of Claims 1-20.

Petitioner does not assert any grounds of anticipation, but asserts two grounds of obviousness. The combination of You, Liu, and Mallick does not teach key claim elements of the ’767 Patent’s Challenged Claims, such as “monitoring a first signaling in X time intervals,” “wherein X is a positive integer,” “the first signaling is used for determining scheduling information for the first radio signal,” “the scheduling information comprises at least one of {occupied time-frequency resource, adopted Modulation Coding Scheme (MCS), subcarrier spacing of subcarriers in occupied frequency domain resource},” “the frequency domain resource used for transmitting the first signaling belongs to a first subband,” “at least

one of {location of the first subband in frequency domain, subcarrier spacing of subcarriers included in the first subband} is used for determining the X time intervals,” “receiving a second radio signal wherein the second radio signal is used for determining at least one of {location of the first subband in frequency domain, subcarrier spacing of subcarriers included in the first subband},” “the first subband belongs to one of the Q subbands, the feature ID of the monitor of the first signaling is used for determining the first subband in the Q subbands,” “wherein any one of the X time intervals belongs to a first time window in time domain, the first time window is divided into Y time intervals,” “the X time intervals are X time intervals of the Y time intervals, Y being a positive integer not smaller than X, the subcarrier spacing of subcarriers included in the first subband is used for determining Y,” “a feature ID of a monitor of the first signaling is used for determining the X time intervals in the Y time intervals,” and “the feature ID of the monitor of the first signaling is used for determining the first time window in the Z time windows.” Petitioner also incorrectly construes “time interval” as limited to either subframes or slots predictably. Such a construction should be rejected since the ’767 Patent describes time intervals as variable ranges of time.

Patent Owner respectfully submits that Petitioner’s deficient arguments, Patent Owner’s arguments presented herein, and the additional evidence submitted herewith, such as the Declaration of Miguel Gomez, and the deposition testimony of

Dr. Harry Bims, demonstrate that the Challenged Claims are patentable. Accordingly, the Board should issue a Final Written Decision finding all the Challenged Claims of the '767 Patent not unpatentable.

II. THE '767 PATENT

The '767 Patent, was filed on April 18, 2018, claiming priority to Chinese Patent Application No. 2017 1 0255811 filed April 19, 2017, and issued on October 29, 2019.

The '767 Patent discloses and claims methods and devices for paging transmissions. The '767 Patent “determines the transmission opportunities of paging according to the numerology employed by the paging” thereby minimizing power consumption and ensuring that “paging capacity basically remains the same” when multiple numerologies are employed in connection with 5G NR networks. '767 Patent, 2:1-15. Unlike legacy LTE systems which utilized fixed timings for Paging Frames (PF) and Paging Occasions (PO), and if applied to multiple numerology schemes would “detect the paging message different times for different numerologies within the 1 millisecond [subframe]” resulting in “greatly increased [power consumption],” the invention of the '767 Patent can utilize subcarrier spacings to schedule paging across multiple numerologies. *Id.* at 1:45-67. The invention can further utilize a frequency domain resource for transmitting a first signaling belonging to a first subband, based on which time intervals for paging are

determined. In one embodiment, FIG. 6 “illustrates an example of a diagram for a relationship between Z time windows and Q subbands . . . [a]t least one of {location of the subband #1 in frequency domain, subcarrier spacing of subcarriers included in the subband #1} is used for determining the X1 time intervals.” *Id.* at 17:44-62.

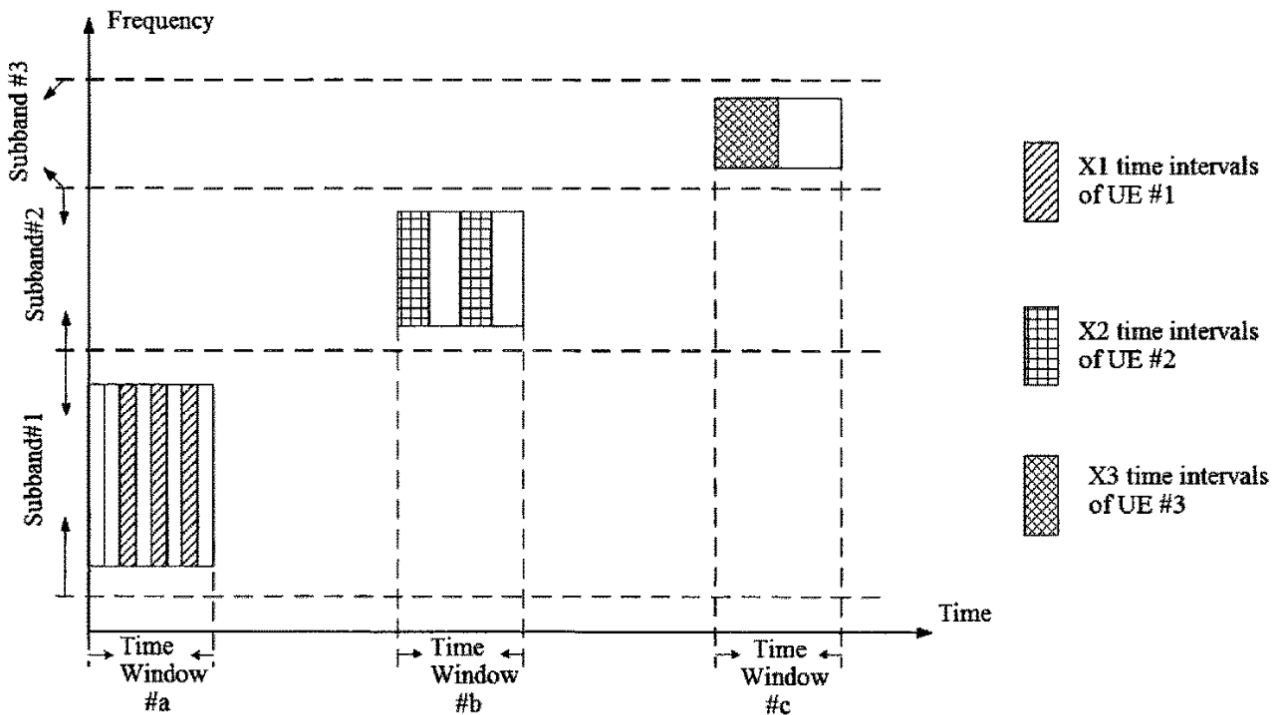


FIG. 6

Id. at FIG. 6.

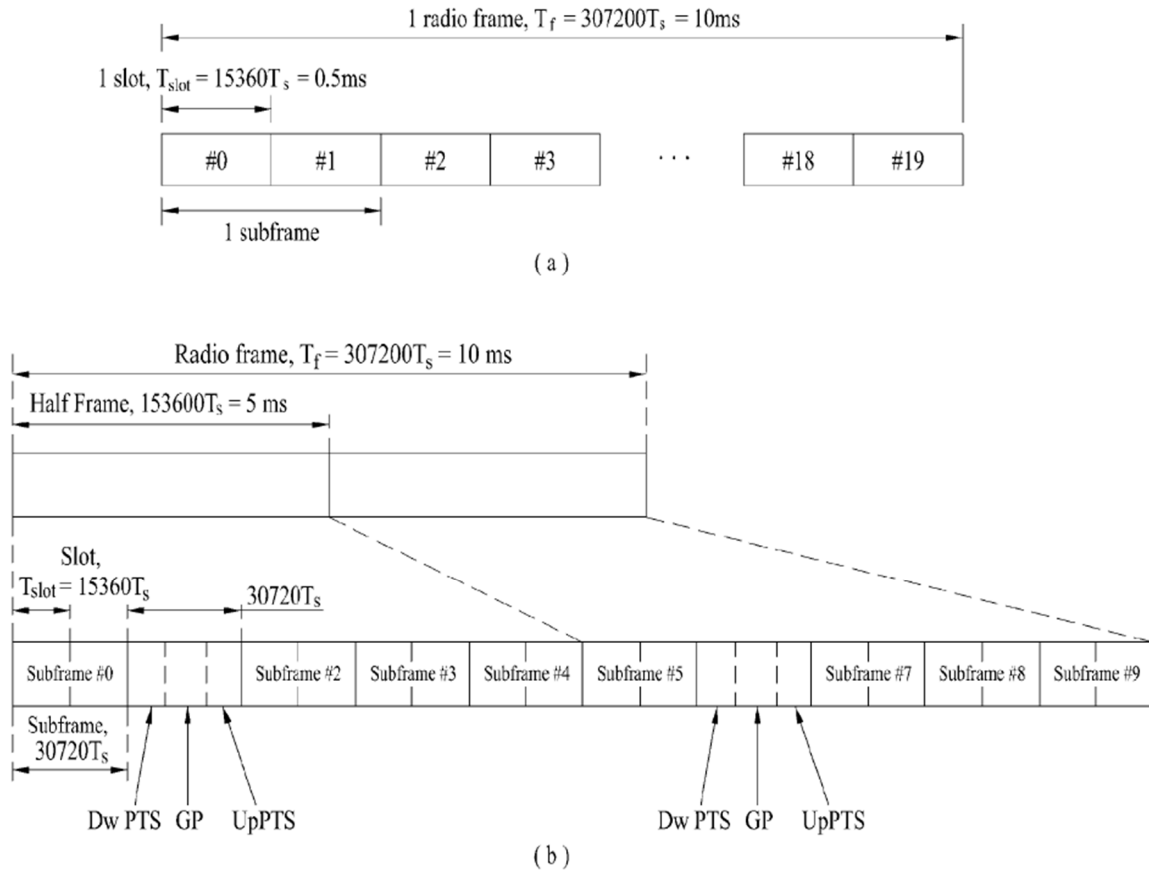
III. THE ALLEGED PRIOR ART

A. WO 2017/052199 (“You”)

You (Ex. 1005) discusses a “control channel within a UE-specific search space (USS)” that a UE may attempt to receive “by assuming that the USS is

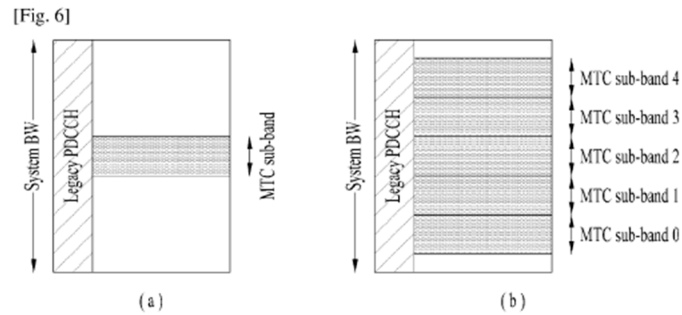
configured in accordance with the configuration of the CSS.” You, Abstract.

You is a typical 4G / LTE system which divides 10ms frames into 1ms subframes, as shown below.



Ex. 1005, Fig. 1; *see also id.*, [50]-[52].

The description of You’s Figure 6 makes clear that each subband corresponds *to a singular subframe* in which M-PDCCH is monitored, as shown below:



Id., Fig. 6.

At this time, a subband (narrowband) for operating the MTC UE may always be located at the center (e.g., 6 center PRBs) of a cell as shown in Fig. 6(a), or several subbands for MTC may be provided *for one subframe* to multiplex MTC UEs as shown in Fig. 6(b), whereby the UEs may use their respective subbands different from each other or the UEs use the same subband not the subband of 6 center PRBs.

Id., [176].

Since You is a 4G / LTE system, its utilization of a System Information Block (SIB) does not include 5G / NR numerology metrics such as the location of subbands in frequency domain or subcarrier spacing of subcarriers included in subbands. You's SIB "includes parameters needed to determine if a specific cell is suitable for cell selection, as well as information about time-domain scheduling of the other SIBs." *Id.*, [70]-[71].

B. WO 2018/126401 ("Liu")

Liu (Ex. 1006) discusses "methods and apparatuses for downlink control information (DCI) transmission and receiving in a wireless communication system."

Liu, Abstract.

Liu is a 5G / NR system. *See* Ex. 1006, [0002]-[0003]. Liu criticizes the faults of conventional 4G / LTE systems, namely that, in 4G / LTE systems, “DCI monitoring is performed per subframe or per slot” or some other fixed length with periodicity and that LTE “cannot support the DCI monitoring occasion change due to numerology and scheduling unit size.” *Id.*, [0004]-[0005].

To that end, Liu discloses periodic slots with fixed length for DCI monitoring occasions.

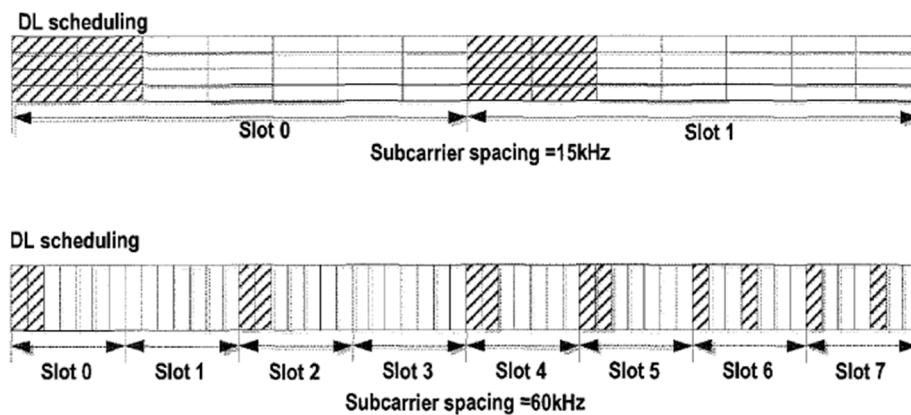


Fig. 2

Id., Fig. 2. Liu’s subcarrier spacing shows the quantity and fixed duration for each of Liu’s slots, as shown above in Fig. 2.

C. WO 2016/136143 (“Mallick”)

Mallick (Ex. 1007) discusses “a method for paging coverage extension UEs in a cell controlled by a radio base station.” Ex. 1007, Abstract.

Mallick describes a periodic subframe per paging cycle, as shown below.

Therefore, for case A and B with NS equals 1 and i_s equals zero, the table would yield the subframe number 9 such that the UE for cases A and B would be paged regularly in subframe 9 of radio frame 76 of every paging cycle.

Id., [0030]. Describing periodic subframes as the time scheduling unit is expected because Mallick is an LTE system, as described below:

Approaches to lower the cost of LTE presently regard the volume of products as the primary reason. . . .

In this respect, the following approaches to lower the cost of LTE, i.e., defining low cost MTC are discussed. . . .

Reduction in supported bandwidth for the low-cost LTE.
. . . .

Modified PDCCH-related design for the low-cost LTE. . .
.

Id. at [0053]-[0056].

IV. CLAIM CONSTRUCTION

During the Institution phase, the Board correctly “agree[d] on this record that the ordinary and customary meaning of ‘subband’ as used in the ’767 patent is a subset of the available frequency band.” Decision, Paper No. 10 at 11. The Board also noted that “[f]or purposes of this Decision, and based on the record before us, we determine that no further construction of any term is necessary.” *Id.* In order to more fully establish the non-obviousness of the challenged claims, Patent Owner

believes that the Board would benefit from an express construction of the term, “time intervals” to make clear its bounds in the context of Petitioner’s arguments. *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (alteration in original) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)) (“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’”). As described below in Section VII.B.1, there is a controversy as to the meaning of “time intervals.” Therefore, Patent Owner proposes the following claim construction: “time intervals” should be construed to mean “variable ranges of time.” Ex. 2004, ¶ 34.

A person of ordinary skill in the art would understand that “time intervals” are “ranges of time,” as Petitioner’s own expert admits:

Q And is it your testimony that the DCI monitoring occasions in Liu is the disclosed time interval or the claimed time interval?

A So it's my opinion that the claimed X time interval defines – the X time intervals rather -- define the – the ***ranges of time*** in which a DCI monitoring occasion is included in the downlink subframe.

Q So in your opinion, X time intervals is not a direct mapping to DCI monitoring occasions; is that right?

A The X time intervals are the ***ranges of time*** within a subframe within which a DCI monitoring occasion

appears within the subframe.

Ex. 2005, 86:16-87:8 (emphases added); Ex. 2004, ¶ 35. Petitioner's expert's definition of "time intervals" comports with the plain and ordinary meaning identified by Wiley Electrical and Electronics Engineering Dictionary:

"interval:

1. *A space or separation between two points*, locations, objects, or the like. For example, the distance between peaks of successive wave cycles.
2. A *given range of values*. For instance, an interval of frequencies or temperatures. Also, a specific range of values, such as the readings an instrument can display.
3. The *time that elapses between the occurrence of two specified events, states, or instants*. For example, the regular intervals at which AC voltage alternates, the irregular intervals at which a circuit with a loose connection might open and close, or the time within which a pulse rises from 0 to its maximum amplitude."

Steven M. Kaplan, Wiley Electrical and Electronics Engineering Dictionary, 2004 (emphases added). *Id.*

Petitioner's expert was also unable to provide a definition of "time interval" beyond that of the term's plain and ordinary meaning or outside of repeating the limitations of Claim 1. Ex. 2004, ¶ 36.

Q Is "time interval" a term of art?

...

A A person of ordinary skill in the art with a master's degree and five years of work experience would apply that

skill to understand what X time intervals means in the context of Claim 1. And that's been what *my testimony has been about, not whether the term "time interval" has a particular meaning to a person of ordinary skill.*

Ex. 2005, 41:14-42:6 (emphasis added).

A person of ordinary skill in the art would understand that the specification of the '767 Patent explicitly construes "time intervals" as variable ranges of time because the relevant embodiments in the specification show that the length of each time interval is variable, and not necessarily following a pattern. Ex. 2004, ¶ 37. As shown below, some time intervals among the X time intervals can be equal in time / symbol length or could have different time / symbol lengths, regardless of the length of slots, subframes, or frames:

In one embodiment, any two of the X time intervals have an equal time length.

In one embodiment, two of the X time times [sic] have different time lengths.

...

In one embodiment, any one of the X time intervals is M OFDM symbols. M is a positive integer smaller than 14.

In one embodiment, any one of the X time intervals is M OFDM symbols. M is a positive integer smaller than 7.

'767 Patent, 2:48-51, 2:58-63, 19:1-4, 19:11-15; Ex. 2004, ¶ 37. Based on the reading of the aforementioned portions of the '767 Patent, a person of ordinary skill in the art would also understand that each time interval need not be equally spaced

between each other since the lengths of the X time intervals within a slot (or across slots), subframe (or across subframes), or frame (or across frames) are of different lengths. *Id.* The diversity of lengths among the X time intervals means that time intervals are variable ranges of time. *Id.*

V. LEVEL OF ORDINARY SKILL IN THE ART

Patent Owner utilizes Petitioner’s proposed level of skill in the art— a person of ordinary skill in the art (“POSITA”) would have had at least a master’s degree in electrical engineering or a related field, and five years of work/research experience in the field of wireless networking. Pet. at 22; Ex. 2004, ¶ 27. Someone with less or different technical education but more relevant practical experience, or more relevant education but less practical experience, could also be considered a POSITA. *Id.*

VI. REQUIREMENTS UNDER 35 U.S.C. § 103

The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art, (2) any differences between the claimed subject matter and the prior art, (3) the level of skill in the art, and (4) where in evidence, so called secondary considerations. *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 17–18 (1966). Failure to identify the differences between the claimed subject matter and the prior art is fatal to an obviousness challenge. *See Apple, Inc. v. Contentguard Holdings, Inc.*, IPR2015-

00355, Paper 9 at 9-10 (P.T.A.B. June 26, 2015).

To arrive at obviousness, the Board must sufficiently explain and support the conclusions that the prior art references disclose all the elements recited in the Challenged Claims and a relevant skilled artisan not only could have made but would have been motivated to combine all the prior art references in the way the patent claims. *Pers. Web Techs., LLC v. Apple, Inc.*, 848 F.3d 987, 994 (Fed. Cir. 2017).

Even if all the claim elements are found across a number of references, an obviousness determination must consider whether a POSITA would have been motivated to combine those references. *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1368 (Fed. Cir. 2016); *Los Angeles Biomedical Rsch. Inst. at Harbor-UCLA Med. Ctr. v. Eli Lilly Co.*, 849 F.3d 1049, 1067 (Fed. Cir. 2017).

The Supreme Court explained in *KSR Int'l Co. v. Teleflex Inc.* that “[o]ften, it will be necessary for a court to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue. To facilitate review, this analysis should be made explicit.” 550 U.S. 398, 418 (2007). This combination determination, as supported by an articulated motivation to combine, requires a

plausible rationale as to why those prior art references would have worked together. *Broadcom Corp. v. Emulex Corp.*, 732 F.3d 1325, 1335 (Fed. Cir. 2013). Additionally, “knowledge of a problem and motivation to solve it are entirely different from motivation to combine particular references.” *Innogenetics, N.V. v. Abbott Lab ’ys.*, 512 F.3d 1363, 1373 (Fed. Cir. 2008).

VII. PETITIONER HAS NOT PROVED INVALIDITY OF THE CHALLENGED CLAIMS BY A PREPONDERANCE OF THE EVIDENCE

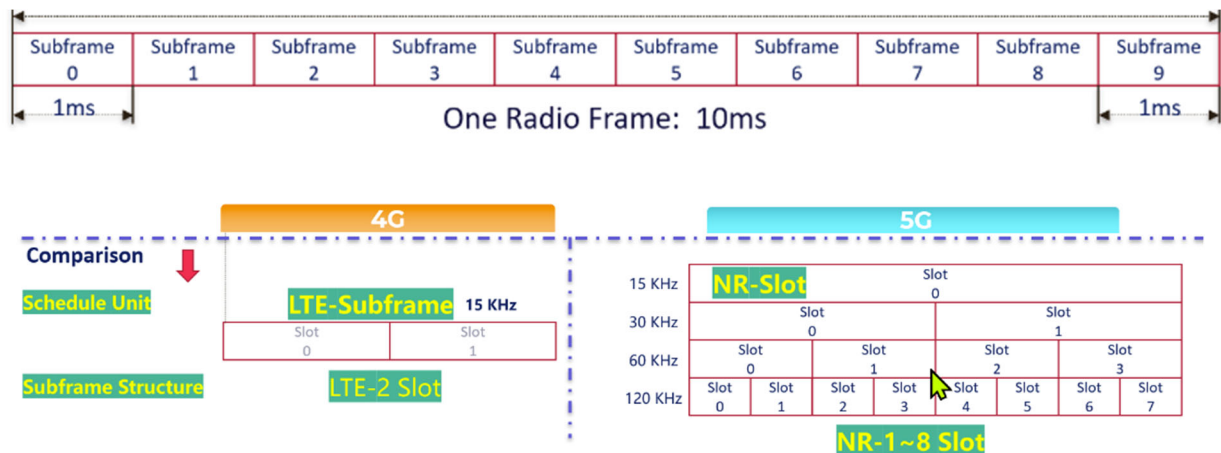
As set forth below, and in view of both the Petition (“Paper No. 1” or “Pet.”) and the Board’s Institution Decision (“Paper No. 10” or “Inst.”), Petitioner has failed to demonstrate by a preponderance of the evidence that the Challenged Claims are obvious in view of the asserted prior art.

A. There is No Motivation to Combine the 4G / LTE Systems of You or Mallick with the 5G / NR System of Liu

Petitioner’s Grounds 1 and 2 rely on the improper combination of You, Liu, and Mallick because a person of ordinary skill in the art would not combine a 4G / LTE system with a 5G / NR system. Ex. 2004, ¶ 36. 4G and 5G systems, while similar in some ways since 5G is a progression from 4G, also have various and substantial differences which make combination not possible. *Id.* A person of ordinary skill in the art would not make the changes alleged by Petitioner, which include regressing to 4G / LTE again (*see infra* Sections VII.B.5 and VII.B.7, which only rely on You, a 4G / LTE system) because those differences were already

considered by standard setting organizations, such as 3GPP, at the time of transitioning to 5G. *Id.*

One pertinent example is that of 4G / LTE systems have a single subcarrier spacing and the number of slots in a subframe are always fixed. *Id.* ¶ 39. A frame is made up of 10 subframes each of 1ms, making the frame duration of 10ms. *Id.* Each subframe carries 2 slots, so 20 slots comprise a complete frame. *Id.* 5G / NR systems have subframes as a numerology independent time reference while a slot is the typical dynamic scheduling unit. *Id.* The difference between scheduling units (subframes in 4G / LTE systems versus slots in 5G / NR systems) is demonstrated below despite that 5G retained the same division of frames into subframes, indicating that any motivation to “combine” was already acted upon:



Id. (citing <https://www.linkedin.com/pulse/4g-vs-5g-key-technology-differencespost-video-mohamed-eladawi>)

The '767 Patent clearly discloses an improvement to a basic 5G / NR system.

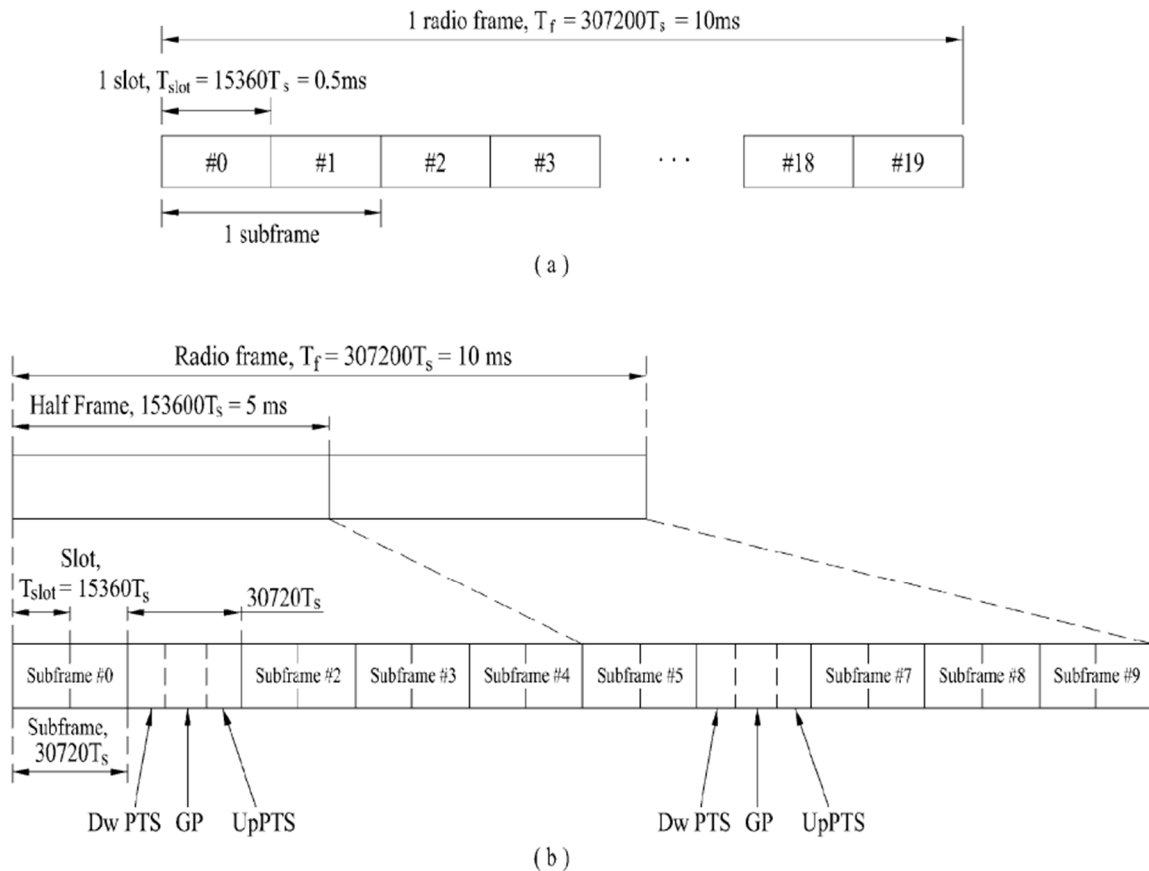
Id. ¶ 40.

In order to solve the above design problem of paging when multiple numerologies are employed in the 5G NR, the present disclosure provides a solution.

'767 Patent, 2:1-3; Ex. 2004 ¶40.

Having established that 4G / LTE and 5G / NR systems are not combinable to create another 5G / NR system, it follows that a person of ordinary skill in the art would not combine You or Mallick with Liu to create the 5G / NR system of the '767 Patent. *Id.*, ¶ 41.

A person of ordinary skill in the art would understand that You is a typical 4G / LTE system which divides 10ms frames into 1ms subframes, as shown below:



Ex. 1005, Fig. 1; *see also* Ex. 1005, [0050]-[0052]; Ex. 2004, ¶ 42.

Petitioner's expert admits that "paging control and scheduling in only particular portions of a subframe¹ and not a search space that is the entirety of a subframe, but a search space that is only a portion of a subframe [] is not something expressly disclosed in You" because You discloses a 4G / LTE system. Ex. 2005, 60:3-25; Ex. 2004, ¶ 43. Petitioner's expert says that scheduling in particularly portions of a subframe is "possible if You were to be [improperly] combined with other art such as Liu" and further notes that "You is not expressly teaching that a UE should search through only a particular portion of a subframe." *Id.* Petitioner's expert also describes, as is conventional for a 4G / LTE system, that "different portions of a subframe in your hypothetical would have different symbol lengths, which is not something expressly disclosed in You" or any conventional 4G / LTE system. Ex. 2005, 61:2-11; Ex. 2004, ¶ 43.

Mallick, like You, is a 4G / LTE system, as described below:

Approaches to lower the cost of LTE presently regard the volume of products as the primary reason...

In this respect, the following approaches to lower the cost of LTE, i.e., defining low cost MTC are discussed...

¹ Despite showing slots in Fig. 1 of You, the inventor (or anybody else) was not motivated to create a system with paging control or scheduling in ***particular portions of a subframe***, such as a slot, let alone the claimed "X time intervals" of the '767 Patent. Ex. 2004, ¶ 43, n. 1

Reduction in supported bandwidth for the low-cost
LTE...

Modified PDCCH-related design for the low-cost LTE...

Ex. 1007 at [0053]-[0056]; Ex. 2004, ¶ 44. As an LTE system, Mallick describes periodic subframes as its basic time scheduling unit, as shown below.

Therefore, for case A and B with NS equals 1 and i_s equals zero, the table would yield the subframe number 9 such that the UE for cases A and B would be paged regularly in subframe 9 of radio frame 76 of every paging cycle.

Ex. 1007, [0030]; Ex. 2004, ¶ 44.

Liu is a 5G / NR system. *See* Ex. 1006, [0002]-[0003]; Ex. 2004, ¶ 45. Like the '767 Patent, Liu criticizes the faults of You / Mallick and other conventional 4G / LTE systems, namely that, in 4G / LTE systems, “DCI monitoring is performed per subframe or per slot” or some other fixed length with periodicity and that LTE “cannot support the DCI monitoring occasion change due to numerology and scheduling unit size.” Ex. 1006, [0004]-[0005]; Ex. 2004, ¶ 45. Because You and Mallick are 4G / LTE systems, they are inapposite to the claims and disclosure of the '767 Patent, and a person of ordinary skill in the art would not be motivated to combine You or Mallick with the 5G / NR system of Liu. Ex. 2004, ¶ 45.

B. Ground 1: The Combination of You and Liu Does Not Render Claims 1 and 4-6 Obvious

1. The Combination of You and Liu Does Not Render Obvious “*monitoring a first signaling in X time intervals,*” as Required by Claim 1

Claim 1 recites the limitation “monitoring a first signaling in X time intervals.”

First, Petitioner incorrectly argues that You discloses this limitation because “*You’s one or more downlink subframes in a paging occasion constitute the claimed ‘X time intervals’ because each subframe is a time interval.*” Pet. at 38 (emphasis added); Ex. 2004, ¶ 46. However, You’s subframes (*i.e.*, fixed ranges of time) are not X time intervals, which are variable ranges of time, meaning that the length of the time intervals are not necessarily equal and the time intervals are not necessarily periodic in time, as described in Section IV. Ex. 2004, ¶ 46.

The ’767 Patent clearly discloses the shortcomings of the 4G / LTE system of You. Ex. 2004, ¶ 47. One of those shortcomings is the failure to include variable ranges of time:

In existing LTE systems, transmission opportunities of paging are defined through a Paging Frame (PF) and a Paging Occasion (PO) uniformly. The PF is a radio frame which is likely to transmit a paging message, and the PO is used for determining a subframe which is likely to transmit a paging message in the PF. The radio frame in LTE has a fixed time length of 10 milliseconds, and the subframe has a fixed time length of 1 millisecond. Since an LTE network generally employs a single numerology

or the numerology basically does not change in a long time in the network, the definition of the possible time of paging using the PF and PO having a fixed time length can simplify the design of system, under the premise of guaranteeing the paging capacity and not increasing the power consumption of UE.

'767 Patent, 1:45-58 (showing that a paging occasion is used for determining a fixed-length subframe to transmit a paging message); Ex. 2004, ¶ 47. While a fixed time length has the advantage of design simplification and minimal power consumption, 4G / LTE systems like You also restrict the time periods for transmission opportunities for paging in subframes. *Id.* Petitioner's expert also testified that "paging control and scheduling in...only a portion of a subframe [] is not something expressly disclosed in You" because You discloses a 4G / LTE system. *Id.*; *see supra* Section IV (citing Ex. 2005, 60:3-61:11).

Second, Petitioner incorrectly argues that Liu discloses this limitation because Liu describes "monitor[ing] one or more DCI monitoring occasions at the slot level." Pet. at 38; Ex. 2004, ¶ 48. However, this is inapposite to the claimed "X time intervals" because the '767 Patent explains prior art 5G / NR systems which utilize different numerologies to compute smaller scheduling units such as slots within 1ms subframes in which to detect the paging message. *Id.* These slots are also fixed ranges of time, which cannot be X time intervals:

Under the 5G NR, a network supports different numerologies, thus, a given time length, for example, 1

millisecond, probably includes 60 multiple basic scheduling units (for example, slot). If the legacy design of the current paging opportunity is employed, the UE would detect the paging message different times for different numerologies within the 1 millisecond. Therefore, power consumption in some numerology would be greatly increased. Meanwhile, the paging capacity varies greatly due to the adoption of different numerologies.

'767 Patent, at 1:58-67; Ex. 2004, ¶ 48. The '767 Patent describes a solution to the problem of the 5G / NR systems employed in Liu where the transmission opportunities of paging (*i.e.*, X time intervals) are determined according to “different numerologies”:

In order to solve the above design problem of paging when multiple numerologies are employed in the 5G NR, the present disclosure provides a solution, which determines the transmission opportunities of paging according to the numerology employed by the paging, thereby guaranteeing that the UE has a small difference in the complexity and power consumption of monitoring the paging message under different numerologies and that the paging capacity basically remains the same.

Id. at 2:1-9; Ex. 2004, ¶ 48. While Liu may describe slot-level monitoring of DCI, Liu does not disclose either the number (X) of time intervals or the duration of each of the X time intervals, which could be variable (*i.e.*, different duration for each interval, and the one paragraph that Petitioner dedicates to Liu points to no such disclosure. *See* Pet. at 38; Ex. 2004, ¶ 48.

In view of Petitioner's failure to show that the combination of You and Liu discloses, teaches, or motivates the claimed "monitoring a first signaling in X time intervals," the combination of You and Liu cannot render Claim 1 obvious.

2. The Combination of You and Liu Does Not Render Obvious "*wherein X is a positive integer*," as Required by Claim 1

Claim 1 recites the limitation "wherein X is a positive integer." Since Petitioner fails to show how the combination of You and Liu discloses, teaches, or suggests "monitoring a first signaling in *X time intervals*," it therefore cannot disclose, teach, or suggest "wherein X is a positive integer." *See supra* Section VII.B.1; Ex. 2004, ¶ 49. For this reason alone, Claim 1 is not rendered obvious by the combination of You and Liu.

The Board should also note Petitioner's changing positions related to its construction of "positive integer." The Petition describes that You in view of Liu teaches that "the paging M-PDCCH is monitored in *one or more (i.e., a positive integer)* time intervals." Pet. at 39 (citing Bims, ¶ 129) (emphasis added); Ex. 2004, ¶ 50. However, that same Dr. Bims testified that "in the context of Claim 1, the number one is not a positive integer." Ex. 2005, 28:2-5, 29:5-10, 34:19-24; Ex. 2004, ¶ 50. Dr. Bims' contradictory testimony is a blatant attempt to match Petitioner's incorrect claim construction in the related district court litigation, where it construed "X time intervals . . . wherein X is a positive integer" as "plural, positive integer

number of time intervals.” See Ex. 2006, at 3; Ex. 2004, ¶ 50.

Dr. Bims’ testimony should be disregarded because Figure 7 of the ’767 patent explicitly points to the case where “X=1 time interval in the first time window,” meaning that “positive integer” in the context of claim 1 means “one or more”:

	Index of X=1 time interval in the first time window			
	Feature ID=a	Feature ID=b	Feature ID=c	Feature ID=d
Y=1	0	0	0	0
Y=2	0	1	0	1
Y=4	0	1	2	3
Y=8	1	3	5	7
Y=16	2	6	10	14

’767 Patent, Fig. 7; Ex. 2004, ¶ 51.

Petitioner’s contradictory construction of “positive integer” fails to provide a Board a coherent argument as to this claim limitation and thus cannot prove that this claim limitation is rendered obvious by the combination of You and Liu by a preponderance of the evidence.

3. The Combination of You and Liu Does Not Render Obvious *“the first signaling is used for determining scheduling information for the first radio signal”* as Required by Claim 1

Claim 1 recites the limitation “the first signaling is used for determining scheduling information for the first radio signal.”

Since Petitioner fails to show how the combination of You and Liu discloses, teaches, or suggests a “monitoring a first signaling in X time intervals,” it therefore cannot disclose, teach, or suggest “the first signaling is used for...” See *supra*

Section VII.B.1; Ex. 2004, ¶ 52. For this reason alone, Claim 1 is not rendered obvious by the combination of You and Liu.

4. The Combination of You and Liu Does Not Render Obvious “*the scheduling information comprises at least one of {occupied time-frequency resource, adopted Modulation Coding Scheme (MCS), subcarrier spacing of subcarriers in occupied frequency domain resource}*” as Required by Claim 1

Claim 1 recites the limitation “the scheduling information comprises at least one of {occupied time-frequency resource, adopted Modulation Coding Scheme (MCS), subcarrier spacing of subcarriers in occupied frequency domain resource}.”

Since Petitioner fails to show how the combination of You and Liu discloses, teaches, or suggests “the first signaling is used for determining scheduling information,” it therefore cannot disclose, teach, or suggest “the scheduling information....” *See supra* Section VII.B.3; Ex. 2004, ¶ 53. For this reason alone, Claim 1 is not rendered obvious by the combination of You and Liu.

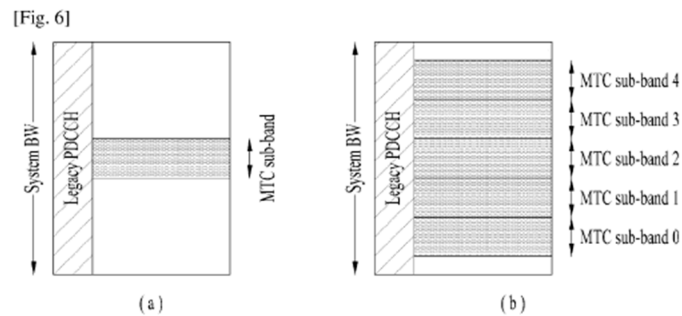
5. The Combination of You and Liu Does Not Render Obvious “*the frequency domain resource used for transmitting the first signaling belongs to a first subband*” as Required by Claim 1

Claim 1 recites the limitation “the frequency domain resource used for transmitting the first signaling belongs to a first subband.”

Since Petitioner fails to show how the combination of You and Liu discloses, teaches, or suggests “monitoring a first signaling in X time intervals,” it therefore

cannot disclose, teach, or suggest “the frequency domain resource used for transmitting the first signaling belongs to a first subband.” *See supra* Section VII.B.4; Ex. 2004, ¶ 54.

Petitioner only relies on You and specifically Fig. 6 of You for this limitation. Pet. at 42; Ex. 2004, ¶ 55. But the specification of Fig. 6 only makes clear the allegedly disclosed subband corresponds *to a singular subframe* in which M-PDCCH is monitored, as shown below:



Ex. 1005, Fig. 6; Ex. 2004, ¶ 55.

At this time, a subband (narrowband) for operating the MTC UE may always be located at the center (e.g., 6 center PRBs) of a cell as shown in Fig. 6(a), or several subbands for MTC may be provided *for one subframe* to multiplex MTC UEs as shown in Fig. 6(b), whereby the UEs may use their respective subbands different from each other or the UEs use the same subband not the subband of 6 center PRBs.

Ex. 1005, [0076]; Ex. 2004, ¶ 55. For the reasons noted above in Sections IV and VII.B.1, time intervals are not subframes. Ex. 2004, ¶ 55. Moreover, under Petitioner’s own construction of “X” or a “positive integer” of time intervals

meaning “more than one subframe” (*see supra* Section VII.B.2), You would not disclose this claim limitation because it only describes *one* subframe per subband. *Id.* For both these reasons, You cannot disclose the claimed “first subband.” *Id.* Petitioner does not and cannot point to Liu with respect to this claim limitation.

Therefore, Claim 1 is not rendered obvious by the combination of You and Liu.

6. The Combination of You and Liu Does Not Render Obvious “*at least one of {location of the first subband in frequency domain, subcarrier spacing of subcarriers included in the first subband} is used for determining the X time intervals,*” as Required by Claim 1.

Claim 1 recites the limitation “at least one of {location of the first subband in frequency domain, subcarrier spacing of subcarriers included in the first subband} is used for determining the X time intervals.”

Since Petitioner fails to show how the combination of You and Liu discloses, teaches, or suggests “X time intervals” or “a first subband” it therefore cannot disclose, teach, or suggest “at least one of {location of the first subband in frequency domain, subcarrier spacing of subcarriers included in the first subband} is used for determining the X time intervals.” *See supra* Section VII.B.1 and Section VII.B.5; Ex. 2004, ¶ 56.

Specifically, Petitioner only relies on Liu to disclose this claim limitation. Pet. at 45-51; Ex. 2004, ¶ 57. But, as described in Section VII.B.1 and shown below, Liu

only discloses periodic slots with fixed length for DCI monitoring occasions, which are not X time intervals:

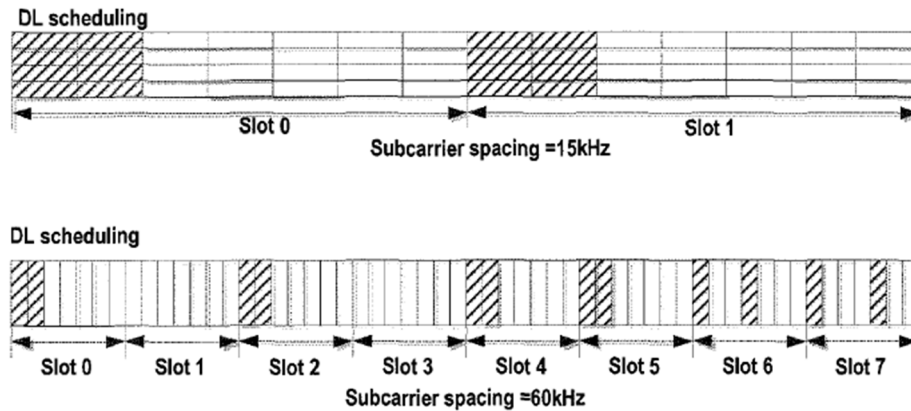


Fig. 2

Ex. 1006, Fig. 2; Ex. 2004, ¶ 57. A person of ordinary skill in the art would understand “determining the X time intervals” to include determining the number of time intervals (*i.e.*, X), the duration of each of the X time intervals, and the spacing between each of the X time intervals. Ex. 2004, ¶ 57. Contrary to Petitioner’s arguments, Liu fails to disclose all three aspects using at least one of “a location of the first subband in frequency domain or subcarrier spacing of subcarriers included in the first subband to determine the X time intervals.” *Id.* Instead, Petitioner argues that Liu’s subcarrier spacing shows the quantity and fixed duration of each of Liu’s slots. Pet. at 45-51; Ex. 2004, ¶ 57. Every one of these slots, according to Petitioner, discloses the X time intervals. *Id.* However, Petitioner’s understanding directly contradicts what a person of ordinary skill would understand to be X time intervals,

which are an X-number of variable ranges of time. *Id.* Since slots have a fixed duration and occupy the entirety of a subframe, as shown in Fig. 2 of Liu displayed above, it would render the term X time intervals redundant and eliminate the possibility of spacing between each of the time intervals. *Id.*

For these reasons, Claim 1 is not rendered obvious by the combination of You and Liu.

7. The Combination of You and Liu Does Not Render Obvious “receiving a second radio signal wherein the second radio signal is used for determining at least one of {location of the first subband in frequency domain, subcarrier spacing of subcarriers included in the first subband},” as Required by Claim 4.

Claim 4 recites the limitation “receiving a second radio signal wherein the second radio signal is used for determining at least one of {location of the first subband in frequency domain, subcarrier spacing of subcarriers included in the first subband}.”

Since Petitioner fails to show how the combination of You and Liu discloses, teaches, or suggests “at least one of {location of the first subband in frequency domain, subcarrier spacing of subcarriers included in the first subband} is used for determining the X time intervals,” it therefore cannot disclose, teach, or suggest “receiving a second radio signal wherein the second radio signal is used for determining at least one of {location of the first subband in frequency domain,

subcarrier spacing of subcarriers included in the first subband}.” *See supra* Section VII.B.6; Ex. 2004, ¶ 58.

While Petitioner relies on the combination of You and Liu for the entirety of the claim limitation, Petitioner only relies on You’s SIB to disclose “the second radio signal” aspect. Pet. at 51-54; Ex. 2004, ¶ 59. However, a person of ordinary skill in the art would understand that You is a 4G / LTE system so its SIB would not determine at least one of {location of the first subband in frequency domain, subcarrier spacing of subcarriers included in the first subband, which are 5G / NR numerology metrics. *Id.* You’s SIB merely “includes parameters needed to determine if a specific cell is suitable for cell selection, as well as information about time-domain scheduling of the other SIBs.” Ex. 1005, [70]-[71]; Ex. 2004, ¶ 59. Additionally, as described in Section VII.A, there is no motivation to combine a 4G / LTE system with a 5G / NR system. *Id.*

Therefore, Claim 4 is not rendered obvious by the combination of You and Liu.

8. The Combination of You and Liu Does Not Render Obvious “*the first subband belongs to one of the Q subbands*,” as Required by Claim 5

Claim 5 recites the limitation “the first subband belongs to one of the Q subbands.”

Since Petitioner fails to show how the combination of You and Liu discloses,

teaches, or suggests “a first subband,” it therefore cannot disclose, teach, or suggest “the first subband belongs to one of the Q subbands.” *See supra* Section VII.B.5; Ex. 2004, ¶ 60.

For this reason alone, Claim 5 is not rendered obvious by the combination of You and Liu.

9. The Combination of You and Liu Does Not Render Obvious “*the feature ID of the monitor of the first signaling is used for determining the first subband in the Q subbands,*” as Required by Claim 5

Claim 5 recites the limitation “the feature ID of the monitor of the first signaling is used for determining the first subband in the Q subbands.”

Since Petitioner fails to show how the combination of You and Liu discloses, teaches, or suggests “the first signaling” or “the first subband” it therefore cannot disclose, teach, or suggest “the feature ID of the monitor of the first signaling is used for determining the first subband in the Q subbands.” *See supra* Sections VII.B.1. and VII.B.5; Ex. 2004, ¶ 61.

For this reason alone, Claim 5 is not rendered obvious by the combination of You and Liu.

C. Ground 2: The Combination of You, Liu, and Mallick Does Not Render Claims 2 and 3 Obvious

1. The Combination of You, Liu, and Mallick Does Not Render Obvious “*wherein any one of the X time intervals belongs to a first time window in time domain,*” as Required by Claim 2

Claim 2 recites the limitation “wherein any one of the X time intervals belongs to a first time window in time domain.”

Since Petitioner fails to show how the combination of You and Liu discloses, teaches, or suggests “time intervals,” it therefore cannot disclose, teach, or suggest “wherein any one of the X time intervals belongs to a first time window in time domain.” *See supra* Sections VII.B.1; Ex. 2004, ¶ 62. For this reason alone, Claim 2 is not rendered obvious by the combination of You and Liu.

Mallick also does not rectify the deficiency of You with Liu because Mallick is a 4G / LTE system, and as such, only describes a periodic subframe per paging cycle, as shown below:

Therefore, for case A and B with NS equals 1 and i_s equals zero, the table would yield the subframe number 9 such that the UE for cases A and B would be paged regularly in subframe 9 of radio frame 76 of every paging cycle.

Ex. 1007, [0030]; Ex. 2004, ¶ 63. Referring to the portion of Mallick above, Petitioner’s expert confirmed that the subframe 9 “in which paging scheduling information would be delivered to the UE” is repeated for each paging cycle:

[Q.] Is it your understanding that this description refers to using a feature ID to determine a subframe in which a paging message is transmitted to the UE?

A. Paragraph 30 is written in the context of describing a DRX cycle, which paragraph 30 calls a paging cycle. And a paging cycle spans multiple radio frames. So what this is saying is that *subframe 9 of radio frame 76, in each and every one of these cycles is what would be the subframe in which the paging scheduling information would be delivered to the UE*. So this is not indicating the location of a single subframe but rather the repetition of a subframe in each DRX paging cycle.

Ex. 2005, 111:16-112:14 (emphasis added); Ex. 2004, ¶ 63. As described in Section VII.B.1, Mallick does not disclose the claimed “time intervals” because a subframe is not the claimed time interval, and because the claimed time interval is variable and not predictably subject to periodicity (*e.g.*, every subframe 9), like in Mallick. *Id.*

For these reasons, Claim 2 is not rendered obvious by the combination of You, Liu, and Mallick.

2. The Combination of You, Liu, and Mallick Does Not Render Obvious “*the first time window is divided into Y time intervals,*” as Required by Claim 2

Claim 2 recites the limitation “the first time window is divided into Y time intervals.”

Since Petitioner fails to show how the combination of You, Liu, and Mallick discloses, teaches, or suggests “time intervals,” it therefore cannot disclose, teach,

or suggest “the first time window is divided into Y time intervals.” *See supra* Sections VII.B.1 and VII.C.1; Ex. 2004, ¶ 64.

For this reason alone, Claim 2 is not rendered obvious by the combination of You, Liu, and Mallick.

3. The Combination of You, Liu, and Mallick Does Not Render Obvious “*the X time intervals are X time intervals of the Y time intervals, Y being a positive integer not smaller than X,*” as Required by Claim 2

Claim 2 recites the limitation “the X time intervals are X time intervals of the Y time intervals, Y being a positive integer not smaller than X.”

Since Petitioner fails to show how the combination of You, Liu, and Mallick discloses, teaches, or suggests “time intervals,” it therefore cannot disclose, teach, or suggest “the X time intervals are X time intervals of the Y time intervals, Y being a positive integer not smaller than X.” *See supra* Sections VII.B.1 and VII.C.1; Ex. 2004, ¶ 65.

For this reason alone, Claim 2 is not rendered obvious by the combination of You, Liu, and Mallick.

4. The Combination of You, Liu, and Mallick Does Not Render Obvious “*the subcarrier spacing of subcarriers included in the first subband is used for determining Y,*” as Required by Claim 2

Claim 2 recites the limitation “the subcarrier spacing of subcarriers included in the first subband is used for determining Y.”

Since Petitioner fails to show how the combination of You, Liu, and Mallick discloses, teaches, or suggests “the first subband” or “Y time intervals,” it therefore cannot disclose, teach, or suggest “the subcarrier spacing of subcarriers included in the first subband is used for determining Y.” *See supra* Sections VII.B.1, VII.B.5, VII.C.1; Ex. 2004, ¶ 66.

For this reason alone, Claim 2 is not rendered obvious by the combination of You, Liu, and Mallick.

5. The Combination of You, Liu, and Mallick Does Not Render Obvious “a feature ID of a monitor of the first signaling is used for determining the X time intervals in the Y time intervals,” as Required by Claim 2

Claim 2 recites the limitation “a feature ID of a monitor of the first signaling is used for determining the X time intervals in the Y time intervals.”

Since Petitioner fails to show how the combination of You, Liu, and Mallick discloses, teaches, or suggests “the first signaling” or “time intervals,” it therefore cannot disclose, teach, or suggest “a feature ID of a monitor of the first signaling is used for determining the X time intervals in the Y time intervals.” *See supra* Sections VII.B.1 and VII.C.1; Ex. 2004, ¶ 67.

For this reason alone, Claim 2 is not rendered obvious by the combination of You, Liu, and Mallick.

6. The Combination of You, Liu, and Mallick Does Not Render Obvious “the feature ID of the monitor of the first signaling is used for determining the first time window in the Z time windows,” as Required by Claim 3

Claim 3 recites the limitation “the feature ID of the monitor of the first signaling is used for determining the first time window in the Z time windows.”

Since Petitioner fails to show how the combination of You, Liu, and Mallick discloses, teaches, or suggests “the first signaling” or “time windows” that include “time intervals” it therefore cannot disclose, teach, or suggest “the feature ID of the monitor of the first signaling is used for determining the first time window in the Z time windows.” *See supra* Sections VII.B.1 and VII.C.1; Ex. 2004, ¶ 68.

For this reason alone, Claim 3 is not rendered obvious by the combination of You, Liu, and Mallick.

D. Any Combination of You, Liu, and Mallick Does Not Render Claims 2-20 Obvious

Claims 2-5 depend upon Claim 1, and for at least the same reasons as Claim 1, any combination of You, Liu, and Mallick, fails to obviate Claims 2-5. Ex. 2004, ¶ 69.

Claims 6-10 recites “[a] method in a base station for paging” that mirrors the claim limitations of Claims 1-5, which recites “[a] method in a User Equipment (UE) for paging.” Ex. 2004, ¶ 70. In other words, Claims 6-10 disclose a method from the perspective of the base station that is in communication with the UE in Claims 1-5.

Id. For at least the same reasons as Claims 1-5, any combination of You, Liu, and Mallick, fails to obviate Claims 6-10. *Id.*

Claims 11-15 recite “[a] UE for paging,” which are the apparatus claims of Claims 1-5. Ex. 2004, ¶ 71. For at least the same reasons as Claims 1-5, any combination of You, Liu, and Mallick fails to obviate Claims 11-15. *Id.*

Claims 16-20 recite “[a] base station device for paging” that mirrors the claim limitations of Claims 11-15, which recites “[a] UE for paging.” Ex. 2004, ¶ 72. In other words, Claims 16-20 discloses the base station device that is in communication with the UE in Claims 11-15. *Id.* For at least the same reasons as Claim 11, any combination of You, Liu, and Mallick fails to obviate Claims 16-20. *Id.*

VIII. CONCLUSION

Petitioner’s combinations fail to render obvious any Challenged Claim. The Board should issue a Final Written Decision finding the Challenged Claims not unpatentable.

Respectfully submitted,

Dated: December 7, 2023

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CERTIFICATE OF WORD COUNT

The undersigned hereby certifies that the portions of the above-captioned PATENT OWNER'S RESPONSE specified in 37 C.F.R. § 42.24 has 7,678 words in compliance with the 14,000 word limit set forth in 37 C.F.R. § 42.24. This word count was prepared using Microsoft Word for Office 365.

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December 7, 2023

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