

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

APEX BEAM TECHNOLOGIES LLC,
Patent Owner

Case IPR2023-00598

Patent No. 10,462,767

**DECLARATION OF DR. HARRY V. BIMS IN SUPPORT OF PETITION
FOR *INTER PARTES* REVIEW**

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I. INTRODUCTION

1. I, Harry V. Bims, Ph.D., have been retained as an independent expert by Samsung Electronics Co., Ltd., and Samsung Electronics America, Inc. (“Petitioner” or “Samsung”) in connection with an *inter partes* review (IPR) of U.S. Patent No. 10,462,767 (“the ’767 patent”) (Ex. 1001). I have prepared this declaration in connection with Samsung’s Petition for *Inter Partes* Review.
2. Specifically, this document contains my opinions about the technology in claims 1-20 of the ’767 patent and the grounds against these claims that have been asserted by Samsung. I was not asked to provide any opinions about the ’767 patent that are not expressed herein.

II. SUMMARY OF OPINIONS

3. This declaration considered claims 1-20 of the ’767 patent. Below, I set forth the opinions I have formed, the conclusions I have reached, and the bases for these opinions and conclusions. I believe the statements contained in this declaration to be true and correct to the best of my knowledge.
4. Based on my experience, knowledge of the art at the time of the applicable priority date (I was told to assume a priority date of April 19, 2017), it is my opinion that claims 1-20 of the ’767 patent would have been obvious based on the asserted grounds.

5. I am being compensated for my time at the rate of \$700 per hour. This compensation is in no way contingent upon the nature of my findings, the presentation of my findings in testimony, or the outcome of this proceeding.

III. QUALIFICATIONS AND BACKGROUND

6. I believe that I am well qualified to serve as a technical expert in this matter based upon my qualifications, discussed in detail below. A copy of my curriculum vitae is attached as Appendix A to this declaration.
7. Based on my education, research, and work experience, I am knowledgeable about the subject matter of the '767 patent and the related prior art.
8. For more than 30 years, since approximately 1981, I have studied, designed, and worked in the field of telecommunications, including wireless communications. During this period, I have designed and implemented various products involving cellular communication technology.
9. I received a B.S. in Computer and Systems Engineering from Rensselaer Polytechnic Institute in 1985. I received an M.S. in Electrical Engineering in 1988 and a Ph.D. in Electrical Engineering in 1993, both from Stanford University. As a graduate student, I studied the principle of Digital Communications theory, including data modulation and demodulation, signal constellations and lattices, channel estimation, equalization, filtering, precoding, synchronization, and trellis coding. My Ph.D. thesis addressed

the application of trellis coding and precoding to a digital modulation system, and was titled “Trellis Coding for Multi-Level, Partial Response Continuous Phase Modulation with Precoding.”

10. After receiving my Ph.D. in 1993, I worked for Glenayre Technologies – Wireless Access Group, where I worked on applications for wireless communication, including inventing, designing, and building a patented two-way pager test system and co-developing a wireless application protocol.
11. In January of 1999, I launched a technology consulting company, Protocomm Systems Inc., which focuses on the development of advanced wireless communications protocols and related software implementations for wireless product companies.
12. From 1999 to 2001, I was also the Director of Software Architecture for Symmetry Communications System. In this position, I was responsible for the software architecture for core SGSN (Serving GPRS Support Node) and GGSN (Gateway GPRS Support Node) products for the GPRS (Generic Packet Radio Services) market. I also held management responsibility for the Firmware, Hardware, Performance, and Systems Engineering Groups.
13. In 2001, I developed a business plan for building network infrastructure for Institute of Electrical and Electronics Engineers (“IEEE”) 802.11 standard (“Wi-Fi”) enterprise networks, and then later that year founded AirFlow

Networks, Inc. where I invented and received eleven patents on a distributed antenna system design for wireless networks, based on the 802.11 wireless local area network specification.

14. I am currently the President of Protocomm Systems, LLC and Bims Laboratories, LLC, both of which I founded. As the President of Bims Laboratories, I perform technical research in wireless technology standards, such as UMTS, LTE/4G, 5G, Wi-Fi, Bluetooth, and other network communication protocols. I am named as an inventor of twenty-three telecommunications related patents.
15. In addition, I am a named Technical Expert and former Vice-Chair and Secretary of the IEEE 802.16 Working Group, which develops technical standards for the wireless protocol commonly known as WiMax. I am also a voting member of the IEEE 802.11 Working Group (which develops technical standards for WiFi), and the IEEE 802.15 Working Group (which develops standards for a variety of specialty wireless networks). Within the IEEE 802.15 Working Group, I am the technical editor for IEEE 802.16t, an amendment to the WiMAX standard that supports long-range wireless networks for the railroad industry. Within the IEEE 802.11 Working Group, I routinely participate and vote on discussions relating to the design of

wireless communications, including packet prioritization, transmission, acknowledgment, and retransmission.

IV. **MATERIALS CONSIDERED**

16. In forming my opinions, I have analyzed the materials listed in the Table below. My opinions are based on my experience, knowledge of the relevant art, the documents identified in the Table below, as well as the documents directly cited to in this declaration.

Exhibit	Description
Ex. 1001	U.S. Patent No. 10,462,767 to Zhang (“’767 patent”)
Ex. 1004	Prosecution History of the ’767 patent (downloaded from Public PAIR)
Ex. 1005	International Patent Application Publication No. 2017/052199 to You et al., filed September 21, 2016, and published March 30, 2017 (“ <i>You</i> ”)
Ex. 1006	International Patent Application Publication No. 2018/126401 to Liu et al., filed January 5, 2017, and published July 12, 2018 (“ <i>Liu</i> ”)
Ex. 1007	International Patent Application Publication No. 2016/136143 to Mallick et al., filed January 28, 2016, and published September 1, 2016 (“ <i>Mallick</i> ”)
Ex. 1008	International Patent Application Publication No. 2018/081913 to Liu et al., filed November 3, 2016, and published May 11, 2018 (“ <i>Liu913</i> ”)
Ex. 1009	U.S. Patent Publication No. 2011/0038330 to Luo et al., filed July 29, 2010, and published February 17, 2011 (“ <i>Luo</i> ”)

Exhibit	Description
Ex. 1010	U.S. Patent Publication No. 2011/0176519 to Vitthaladevuni et al., filed November 15, 2010, and published July 21, 2011 (“ <i>Vitthaladevuni</i> ”)
Ex. 1011	U.S. Patent Publication No. 2013/0308608 to Hu et al., filed March 15, 2013, and published November 21, 2013 (“ <i>Hu</i> ”)
Ex. 1012	U.S. Patent Publication No. 2017/0331670 to Parkvall et al., filed May 13, 2016, and published November 16, 2017 (“ <i>Parkvall</i> ”)
Ex. 1013	U.S. Patent Publication No. 2012/0122495 to Weng et al., filed November 11, 2010, published May 17, 2012 (“ <i>Weng</i> ”)
Ex. 1014	U.S. Patent Publication No. 2017/0094547 to Yum et al., filed September 23, 2016, and published March 30, 2017 (“ <i>Yum</i> ”)
Ex. 1015	International Patent Publication No. 2017/174469 to Wong et al., filed March 31, 2017, and published October 12, 2017 (“ <i>Wong</i> ”)
Ex. 1016	International Patent Publication No. 2017/079574 to Lee et al., filed November 4, 2016, and published May 11, 2017 (“ <i>Lee</i> ”)
Ex. 1017	International Patent Publication No. 2015/113664 to Webb et al., filed November 13, 2014, and published August 6, 2015 (“ <i>Webb</i> ”)
Ex. 1018	U.S. Patent Publication No. 2010/0202382 to Park et al., PCT filed September 11, 2008, and published August 12, 2010 (“ <i>Park</i> ”)
Ex. 1019	Erik Dahlman et al., <i>4G LTE/LTE-Advanced for Mobile Broadband</i> , 2011 (“ <i>Dahlman</i> ”)
Ex. 1020	International Patent Publication No. 2017/079530 to Pelletier, filed November 4, 2016, and published May 11, 2017 (“ <i>Pelletier</i> ”)

Exhibit	Description
Ex. 1021	International Patent Publication No. 2016/130175 to Fwu et al., filed August 11, 2015, and published August 18, 2016 (“Fwu”)
Ex. 1022	Frank Schaich et al., <i>Subcarrier Spacing - How to Make Use of This Degree of Freedom</i> , 2016 IEEE 83rd Vehicular Technology Conference (“Schaich”)
Ex. 1023	U.S. Patent No. 9,131,490 to Feng et al., issued September 8, 2015 (“Feng”)
Ex. 1024	U.S. Patent No. 9,380,568 to Harrison et al., issued June 28, 2016 (“Harrison”)
Ex. 1025	International Patent Publication No. 2017/023352 to Xiong et al., filed December 16, 2015, and published February 9, 2017 (“Xiong”)
Ex. 1026	International Patent Publication No. 2017/026983 to Khoryaev et al., filed December 26, 2015, and published February 16, 2017 (“Khoryaev”)
Ex. 1027	International Patent Publication No. 2017/171398 to Yi et al., filed March 29, 2017, and published October 5, 2017 (“Yi”)
Ex. 1028	U.S. Patent Publication No. 2017/0215170 to Islam et al., filed January 26, 2016, and published July 27, 2017 (“Islam”)
Ex. 1034	3GPP TS 36.211 v11.3.0 (“Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation (Release 11)”) (June 2013)
Ex. 1035	3GPP TS 36.304 v13.0.0 (“Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode (Release 13)”) (December 2015)
Ex. 1036	3GPP TS 36.331 v13.0.0 (“Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio

Exhibit	Description
	Access (E-UTRA); Radio Resource Control (RRC); Protocol specification (Release 13)”) (December 2015)

V. LEGAL STANDARDS

17. I am not a lawyer. My understanding of the legal standards to apply in reaching the conclusions in this declaration is based on discussions with counsel for Petitioner, my experience applying similar standards in other patent-related matters, and my reading of the documents submitted in this proceeding. In preparing this declaration, I have tried to faithfully apply these legal standards to the challenged claims.
18. I have been informed that there are two ways in which prior art may render a patent claim unpatentable. First, I have been informed that the prior art can “anticipate” a claim. Second, I have been informed that the prior art can render a claim “obvious” to a person of ordinary skill in the art. I understand that a claim is patentable if it was not anticipated and would not have been obvious by the prior art at the effective filing date of the patent.
19. I have been informed that a dependent claim is a patent claim that refers back to another patent claim. I have been informed that a dependent claim includes all of the limitations of the claim to which it refers.
20. I have been asked to provide my opinions as to whether the cited prior art teaches or renders obvious claims 1-20 of the ’767 patent from the

perspective of a person of ordinary skill in the art at the '767 patent's earliest claimed priority date in 2017, as described in more detail below.

21. I have been informed that in *inter partes* review proceedings, such as this one, the party challenging the patent bears the burden of proving unpatentability by a preponderance of the evidence. I understand that a preponderance of the evidence means "more likely than not."
22. For purposes of this declaration, I have been asked to provide my opinions on issues regarding unpatentability. I have been informed of the following legal standards, which I have applied in forming my opinions.

A. Level of Ordinary Skill

23. I have been informed a person of ordinary skill in the art is determined by considering several factors, including the (i) type of problems encountered in the art; (ii) prior art solutions to those problems; (iii) rapidity with which innovations are made; (iv) sophistication of the technology; and (v) educational level of active workers in the field.
24. I have been instructed to assume a person of ordinary skill in the art is not a specific real individual, but rather a hypothetical individual having the qualities reflected by the factors discussed above.

B. Prior Art

25. I have been advised and understand the information used to evaluate whether an invention was new and not obvious when made is generally referred to as “prior art.” I understand that prior art includes patents and printed publications that existed before the earliest claimed priority date or the earliest filing date of the patent (which I have been informed is also called the “effective filing date”). I have been informed and understand that a patent or published patent application is prior art if it was filed before the earliest filing date of the claimed invention and that a printed publication is prior art if it was publicly available before the earliest filing date.

C. Anticipation

26. I have been informed that under 35 U.S.C. § 102, a patent claim is unpatentable for anticipation if the claimed subject matter was patented or described in a printed publication before the effective filing date of the claimed invention. I have been informed that this is referred to as unpatentability by anticipation. I have been informed that a patent claim is anticipated under § 102 if a single prior art reference discloses all limitations of the claimed invention.

D. Obviousness

27. I have been informed that obviousness under 35 U.S.C. § 103, a patent claim is unpatentable if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious to a person having ordinary skill in the art to which said subject matter pertains at the time the invention was made. I have been informed that this is referred to as unpatentability by obviousness.
28. I have been informed that a proper obviousness analysis includes the following:
- a. Determining the scope and content of the prior art;
 - b. Ascertaining the differences between the prior art and the claims at issue;
 - c. Resolving the level of ordinary skill in the pertinent art; and
 - d. Considering evidence of secondary indicia of non-obviousness (if available).
29. I have been informed that the relevant time for considering whether a claim would have been obvious to a person of ordinary skill in the art is the time of invention. For my obviousness analysis, counsel for Petitioner instructed me to assume that the date of invention for the Challenged Claims is April 19, 2017. My opinions would not change if I assumed a later date of invention.

30. I have been informed that a reference may be modified or combined with other references or with a person of ordinary skill in the art's own knowledge if the person would have found the modification or combination obvious. I have also been informed that a person of ordinary skill in the art is presumed to know all the relevant prior art, and the obviousness analysis may take into account the inferences and creative steps that a person of ordinary skill in the art would employ.
31. I have been informed that whether a prior art reference renders a patent claim obvious is determined from the perspective of a person of ordinary skill in the art. I have also been informed that, while there is no requirement that the prior art contain an express suggestion to combine known elements to achieve the claimed invention, and while a suggestion to combine known elements to achieve the claimed invention may come from the prior art as a whole or individually and may consider the inferences and creative steps a person of ordinary skill in the art would employ, as filtered through the knowledge of one skilled in the art, obviousness grounds cannot be sustained by mere conclusory statements and must include some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.

32. In determining whether a prior art reference could have been combined with another prior art reference or other information known to a person having ordinary skill in the art, I have been informed that the following principles may be considered:

- a. A combination of familiar elements according to known methods is likely to be obvious if it yields predictable results;
- b. The substitution of one known element for another is likely to be obvious if it yields predictable results;
- c. The use of a known technique to improve similar items or methods in the same way is likely to be obvious if it yields predictable results;
- d. The application of a known technique to a prior art reference that is ready for improvement to yield predictable results;
- e. Any need or problem known in the field and addressed by the reference can provide a reason for combining the elements in the manner claimed;
- f. A person of ordinary skill often will be able to fit the teachings of multiple references together like a puzzle; and
- g. The proper analysis of obviousness requires a determination of whether a person of ordinary skill in the art would have a “reasonable expectation of success”—but not “absolute predictability” of

success—in achieving the claimed invention by combining prior art references.

33. I have been informed that, when a work is available in one field, design alternatives and other market forces can prompt variations of it, either in the same field or in another. I have been informed that if a person of ordinary skill in the art could have implemented a predictable variation and would have seen the benefit of doing so, that variation is likely to have been obvious. I have been informed that, in many fields, there may be little discussion of obvious combinations, and in these fields market demand—not scientific literature—may drive design trends. I have been informed that, when there was a design need or market pressure and there are a finite number of predictable solutions, a person of ordinary skill in the art would have had a good reason to pursue those known options.
34. I have been informed that the law permits the application of “common sense” in examining whether a claimed invention would have been obvious to a person skilled in the art. For example, I have been informed that combining familiar elements according to known methods and in a predictable way may suggest obviousness when such a combination would yield nothing more than predictable results. I understand, however, that a claim is not obvious merely because every claim element is disclosed in the

prior art and that a party asserting obviousness must still provide a specific motivation to combine or modify the references as recited in the claims and explain why one skilled in the art would have reasonably expected to succeed in doing so.

35. I have been informed that there is no rigid rule that a reference or combination of references must contain a “teaching, suggestion, or motivation” to combine references. But I also understand that the “teaching, suggestion, or motivation” test can be a useful guide in establishing a rationale for combining elements of the prior art. I have been informed that this test poses the question as to whether there is an express or implied teaching, suggestion, or motivation to combine prior art elements in a way that realizes the claimed invention, and that it seeks to counter impermissible hindsight analysis.
36. I am not aware of any evidence of secondary considerations that would support a determination of non-obviousness of the claimed subject matter in the '767 patent.
37. I have been informed that, in an obviousness analysis, prior art must be analogous prior art to the patent being considered. I have been informed that a prior art reference is considered to be analogous, or in the same field of art, if the reference is either (1) in the same field of endeavor as the challenged

patent, regardless of the problems the challenged patent and the prior art address, or (2) reasonably pertinent to the particular problem being solved by the challenged patent.

VI. STATE OF THE ART

A. 3rd Generation Partnership Project (3GPP)

38. As the “Background” of the ’767 patent acknowledges, the alleged invention was aimed at responding to the call of “the 3rd Generation Partner Project (3GPP) . . . to conduct the study of New Radio (NR) . . . to standardize the 5G NR.” ’767 Patent, 1:25-31.
39. 3GPP is a consortium of standards-setting organizations that has developed technical standards for multiple generations of mobile communication technologies, including 3rd generation wireless networks (3G), 4th generation wireless networks / Long Term Evolution (4G/LTE), and 5th generation wireless networks / new radio (5G/NR). These technologies are referred to as Radio Access Technologies (“RAT”), and the networks that operate them referred to as Radio Access Networks (“RAN”). *Fwu*, [0033]; *Xiong*, [0022]. These RANs wirelessly communicate with mobile devices, referred to as user equipment (“UE”). *Vitthaladevuni*, [0042]. Typically, 3GPP settles on its technical specifications by accepting proposals from its

members, who then discuss, revise, and ultimately vote to adopt techniques as standard.

40. The development of specifications by 3GPP has been and remains an ongoing, collaborative effort involving hundreds of engineers from many companies. These efforts often focus on the speed and efficiency (e.g., conserving UE battery power) of transmissions, whether through communications between UEs, “uplink” communications from the UE to the BS, or “downlink” communications from the BS to the UE. 3GPP captures updates in different releases, each building on each other. The reason the standards build on each other is simple and relates to the need for long term investment and backwards compatibility in common infrastructure and mobile user equipment.
41. I understand that ’767 patent and the prior art cited in this IPR pertain to physical layer (PHY) downlink (DL) signaling from the BS to the UE. ’767 patent, 1:37-41.
42. The ’767 patent describes several concepts common to both conventional 4G/LTE and emerging 5G/NR technologies. The similarities extend from basic concepts of resource grids, frame structures, and numerologies to using subcarrier spacing to determine the monitoring occasions of the paging scheduling information. While presented in a complex manner in the ’767

patent claims, these were fundamental and well known technologies before the patent's filing.

B. 4th Generation Wireless Networks / Long Term Evolution (4G/LTE)

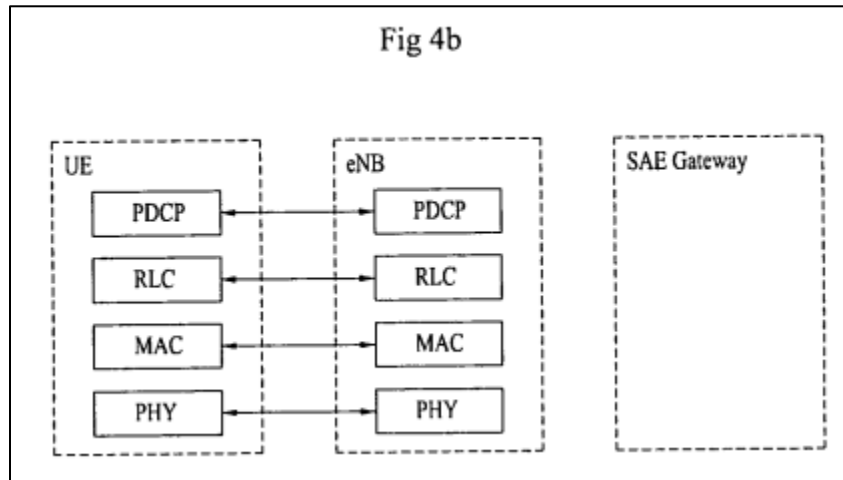
43. Several concepts and techniques used in 4G/LTE or previous generations (e.g., 3G networks) are described below. Many schemes, such as those described below, are designed to “expand and improve coverage and system capacity” and require “flexible use of a frequency band” to accommodate “a coverage-limited terminal device . . . a so-called machine type communication (MTC) device. *Yi*, [2]; *Webb*, 1:23–39.

1. Physical Downlink Signaling

44. “Radio interface protocol layers between the UE and the network including the eNode-B are classified into a first layer (L1), a second layer (L2), and a third layer (L3) on the basis of three lower layers of an Open System Interconnection (OSI) reference model well known to a communication system field.”¹ *Park*, [0010]. “The first layer (L1) provides an information transfer service using a physical channel.” *Id.* Moreover, as commonly used in the field of wireless communication, “downlink” refers to “communication from an eNode-B (eNB) to a user equipment (UE),” and

¹ The 4G/LTE standards use “eNode-B” or “eNB” to denote a base station.

“uplink” refers to “communication from the UE to the eNode-B.” *Id.*, [0065]. Since the '767 patent and the prior art cited in this IPR pertain to physical layer (PHY) downlink (DL) signaling, my discussion below will focus on concepts and techniques used in this area. '767 patent, 1:37-41.

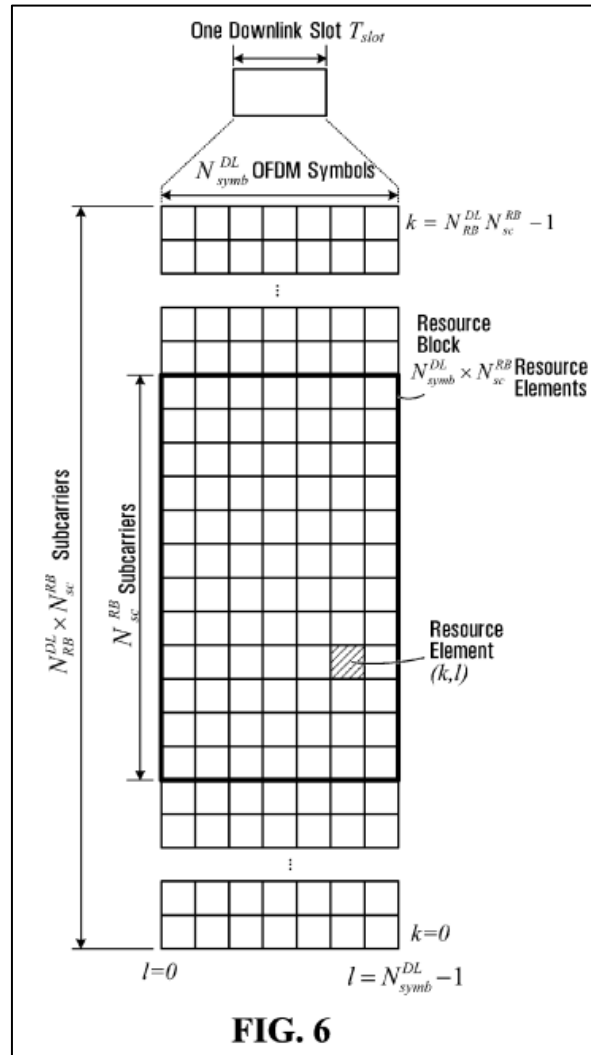


Park, Fig. 4b.

2. Resource Grid

45. In wireless communication (including 4G/LTE and 5G/NR), the radio resources used in the transmission of signals can be represented through a time-frequency resource grid. For example, the following figure illustrates a resource grid in which the horizontal axis represents the time domain and the vertical axis represents the frequency domain. *Weng*, [0191]. The smallest rectangles in the grid are called “resource elements,” each of which spans one symbol in the time domain and one subcarrier in the frequency domain.

Wong, 5:27-30. The frequency span of a subcarrier is called “subcarrier spacing.”



Weng, Fig. 6.

3. Frame Structure

46. Activities in human society are organized using time units such as hour, minute, and second. Similarly, in isochronous wireless communication such as is used in 4G/LTE and 5G/NR, the transmission of physical layer signals

(i.e., the radio resources used for transmitting the wireless signals) is scheduled using various time durations such as the frame, subframe, slot, or orthogonal frequency-division multiplexing (OFDM) symbol time periods that may be modified. *Yi*, ¶38. Specifically, in physical downlink signaling (e.g., paging) for 4G/LTE technology, a frame “is 10 ms long.” *Weng*, [0178]. “Within each frame, there are 10 equal-length subframes with two slots in each subframe.” *Id.*, [0179]. “Within each slot, there are 7 OFDM symbols” or “6 OFDM symbols.” *Id.*, [0180].

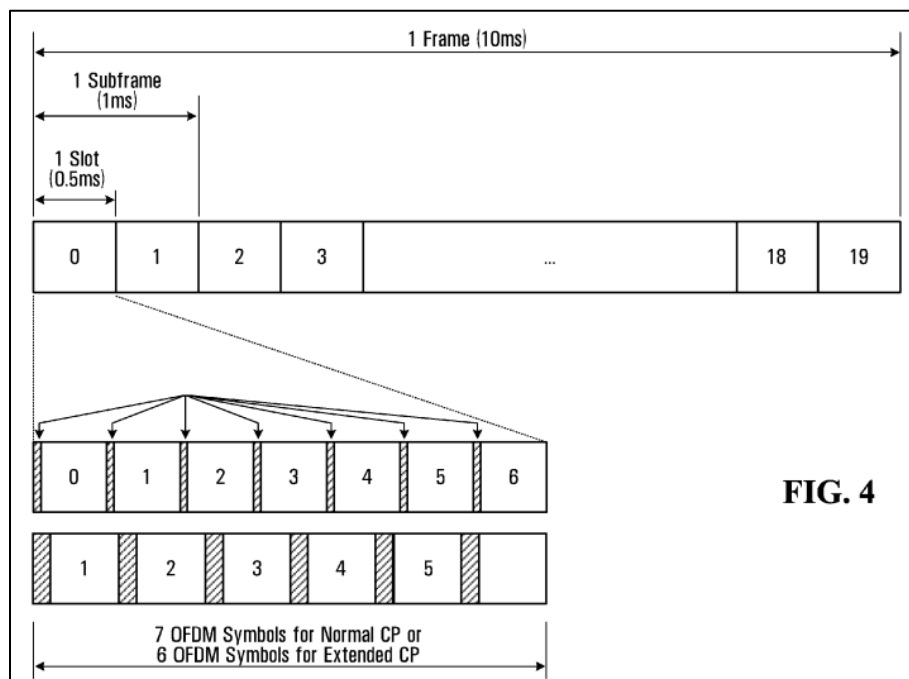
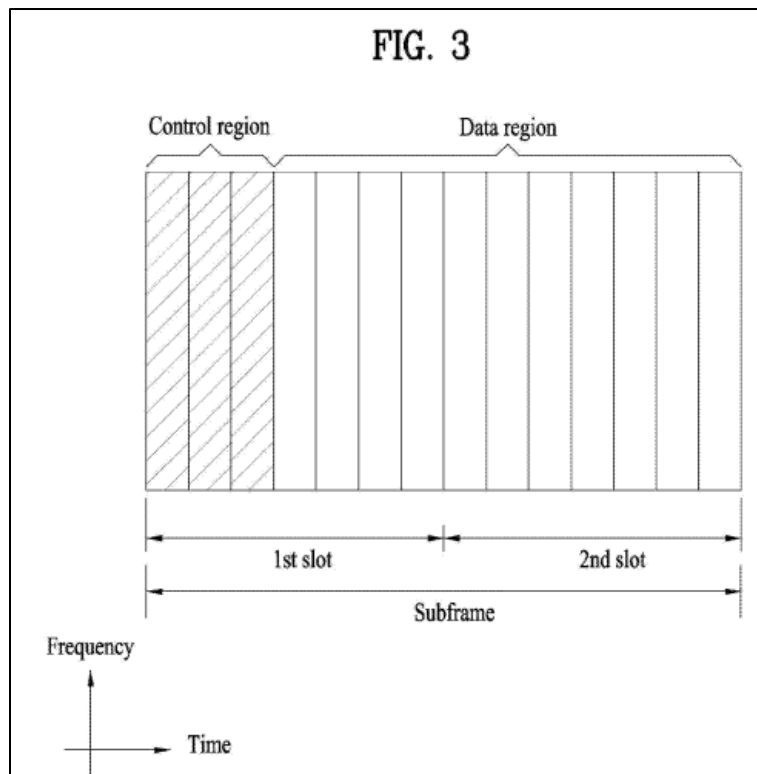


FIG. 4

Id., Fig. 4.

47. Further, in the time domain, a subframe can be “divided into a control region and a data region.” *Yum*, [0058], Fig. 3; *Harrison*, 9:18-45, Fig. 2. In some cases, as shown in *Yum*’s Figure 3 below, the first 1-4 symbols in the

subframe are allocated to the control region, while the remaining symbols of the subframe are allocated to the data region. *Yum*, [0058]. Alternatively, the control region may be located in the rear portion of the subframe. *You*, [144]. Regardless of the approach, the control region contains control information that can be used by a UE to decode the information transmitted in the data region.



Yum, Fig. 3.

4. Subcarrier Spacing

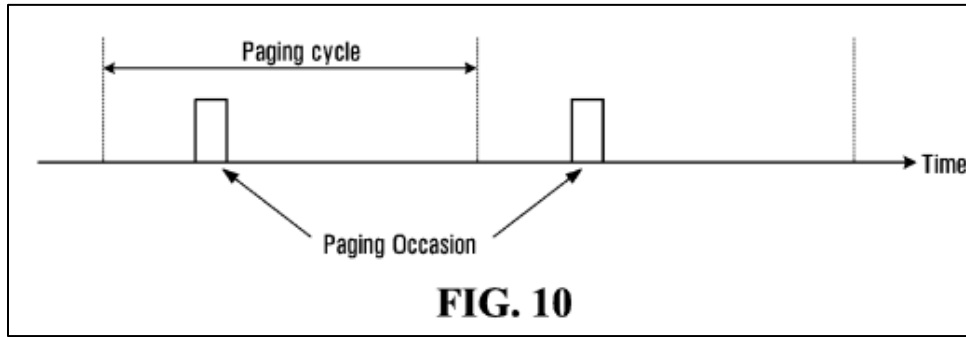
48. It had been understood by persons of ordinary skill that, in the context of any particular network, the subcarrier spacing in the resource grid correlates to the time duration of an OFDM symbol and/or a slot (referred to as “symbol

duration” and “slot duration,” respectively) in the context of 4G/LTE. For example, the 4G/LTE specifications defined that a 15 kHz subcarrier spacing has a corresponding OFDM symbol duration of 66.7 μ s, whereas a 7.5 kHz subcarrier spacing has a corresponding OFDM symbol duration that is twice as long. *Dahlman*, 127-128; Ex. 1034, §6.2.3 (Table 6.2.3-1 showing parameters of OFDM symbols corresponding to 15 and 7.5 kHz subcarrier spacings, respectively); *see also Khoryaev*, 3:21-39, 15:8-34, 9:19-31 (describing 15, 30, and 60 kHz subcarrier spacings respectively corresponding to slot durations of 0.5, 0.25, and 0.125 ms for 4G/LTE vehicle-to-vehicle communications). It was thus understood that in addition to the subcarrier spacing of 15 kHz, 4G/LTE also uses other subcarrier spacings that could result in different frame structures (e.g., 133.4 μ s at 7.5 kHz).

49. Nevertheless, for typical deployments of 4G/LTE, the subcarrier spacing used for physical downlink transmission (e.g., paging) is fixed at 15 kHz. *Dahlman*, 127; *Wong*, 5:20-21. Thus, the frame structure used in 4G/LTE physical downlink transmission is also fixed. Such fixed frame structure in 4G/LTE corresponds to the 15 kHz subcarrier spacing and is described in Section VI.B.3.

5. Paging

50. In wireless network transmissions, paging is a mechanism commonly used by wireless communication systems to conserve UE battery power. *Weng*, [0003]; *Park*, [0030]. Specifically, when there is no data exchanged between a UE and a base station for an extended period of time, the UE will switch from an active/connected mode to an idle mode, sometimes also referred to as a “dormant mode.” *Parkvall*, [0011]. In the idle mode, the UE periodically checks whether the base station is sending any paging messages to the UE. If a paging message for the UE is detected, the UE will switch back to the active/connected mode and start to exchange data with the base station again. The occasions in which the UE checks for paging messages are called “paging occasions,” and the period of paging occasions is called a “paging cycle.” *Park*, [0141], Fig. 11. The following figure illustrates the concept of a paging cycle and a specific paging occasion for a UE. *Weng*, [0227]. The paging cycle length may range, from a few subframes to hundreds of frames. *Weng*, [0228]. The paging occasion may correspond to a subframe. *Weng*, [0229].

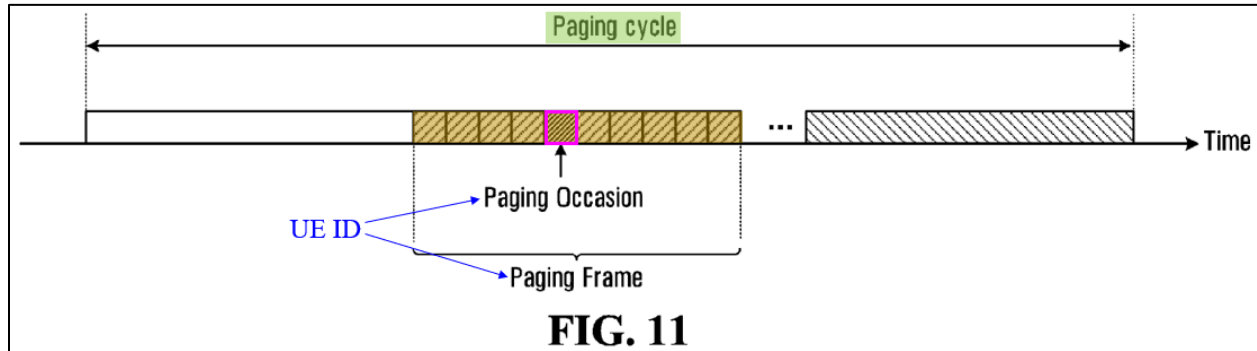


Weng, Fig. 10.

51. For 4G/LTE networks, the paging process is described in 3GPP TS 36.304 (Ex. 1035), and 3GPP TS 36.331 (Ex. 1036), and is used to transmit paging information from a base station to a UE when the UE is in idle mode.

Mallick, [0013]-[0014], [0025]-[0031].

52. The following figure illustrates the concept of a **paging cycle** and a **paging occasion** associated with a UE. *Weng*, [0227]. The **paging occasion** may correspond to a subframe contained in a frame called a “**paging frame**,” and the **paging cycle** length may range from a few subframes to hundreds of frames. *Id.*, [0228]-[229], [235]-[236]. The location of the **paging frame** in the **paging cycle** and the location of the **paging occasion** in the **paging frame** are determined based on the **UE’s ID**. *Id.*, [235]-[236].



Weng, Fig. 11.²

53. For example, the following excerpt of Ex. 1035 describes equations for determining the paging frame and paging occasion based on the UE_ID.

7 Paging

7.1 Discontinuous Reception for paging

The UE may use Discontinuous Reception (DRX) in idle mode in order to reduce power consumption. One Paging Occasion (PO) is a subframe where there may be P-RNTI transmitted on PDCCH addressing the paging message. One Paging Frame (PF) is one Radio Frame, which may contain one or multiple Paging Occasion(s). When DRX is used the UE needs only to monitor one PO per DRX cycle.

PF and PO is determined by following formulae using the DRX parameters provided in System Information:

PF is given by following equation:

$$\text{SFN mod } T = (T \text{ div } N) * (\text{UE_ID mod } N)$$

Index i_s pointing to PO from subframe pattern defined in 7.2 will be derived from following calculation:

$$i_s = \text{floor}(\text{UE_ID}/N) \text{ mod } N_s$$

Ex. 1035, §7.1.

² All figures in this declaration containing color are annotated relative to the original figures in the patent or prior art and all text in color is added.

54. As another example, the following excerpt of Ex. 1036 describes that a default paging cycle includes a positive integer number of radio frames.

Release 13	311	3GPP TS 36.331 V13.0.0 (2015-12)
RadioResourceConfigCommon field descriptions		
additionalSpectrumEmissionSCell The UE requirements related to <i>additionalSpectrumEmissionSCell</i> are defined in TS 36.101 [42]. E-UTRAN configures the same value in <i>additionalSpectrumEmissionSCell</i> for all SCell(s) of the same band with UL configured. The <i>additionalSpectrumEmissionSCell</i> is applicable for all serving cells (including PCell) of the same band with UL configured.		
defaultPagingCycle Default paging cycle, used to derive 'T' in TS 36.304 [4]. Value rf32 corresponds to 32 radio frames, rf64 corresponds to 64 radio frames and so on.		

Ex. 1036, §6.3.2.

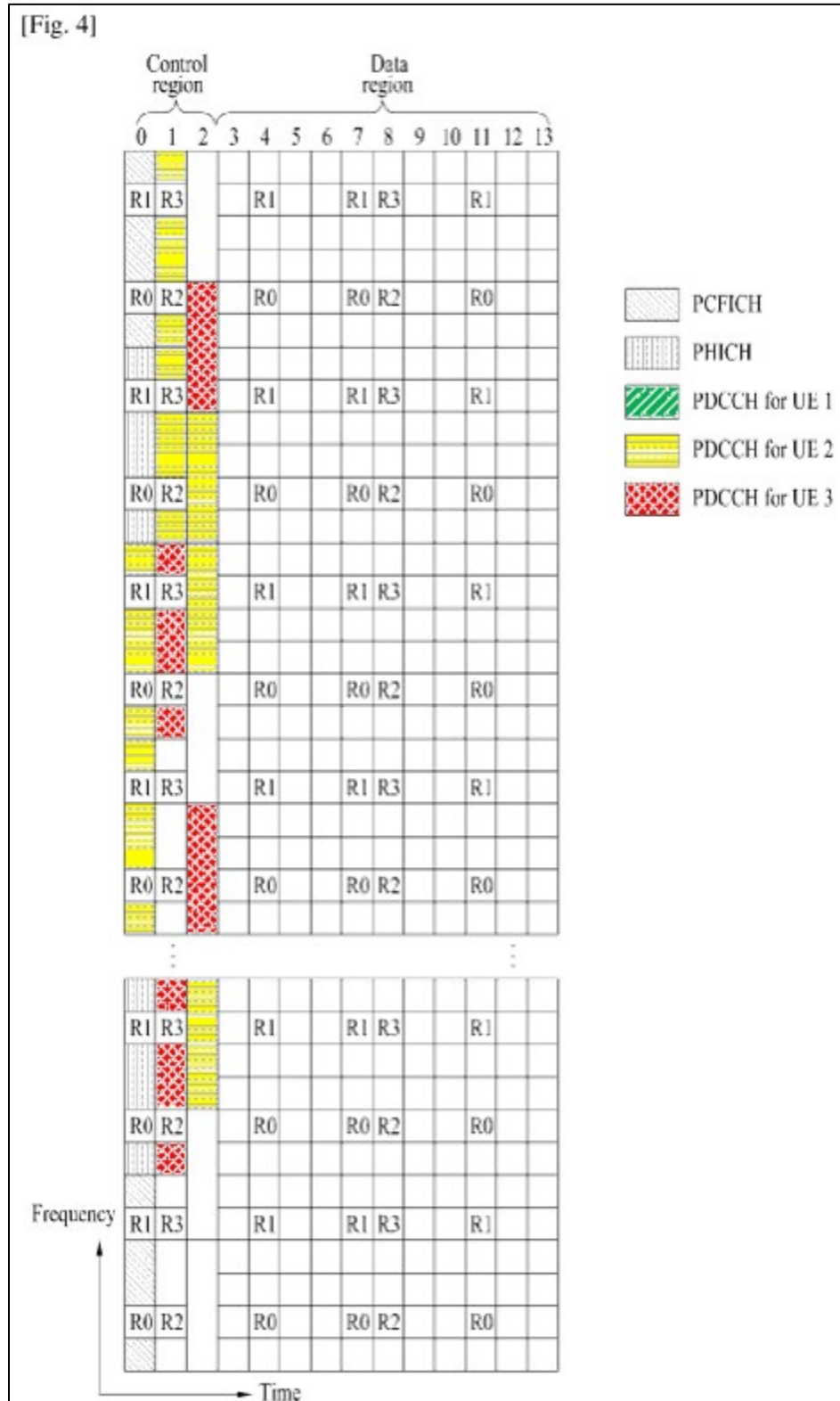
6. Monitoring of Physical Downlink Control Channel (PDCCH)

55. As discussed in Section VI.B.3, the part of the resource grid used for transmitting control information (e.g., paging scheduling information) is called the control region, while the part of the resource grid used for transmitting the actual data (e.g., the actual paging message) is called the data region. As an exemplary implementation, the control region of a subframe may contain one or more physical downlink control channels (PDCCHs), and the data region of the subframe may contain one or more physical downlink shared channels (PDSCHs), where each of these channels is a frequency band. *You*, [95]. Here, each channel has a two-dimensional allocation consisting of subsets of subcarrier frequencies for each OFDM symbol within a set of contiguous OFDM symbols. A PDCCH is used for

transmitting control information (called “downlink control information” or “DCI”) for locating and decoding the resources on a PDSCH that is in a subsequent subframe of the PDCCH. *Weng*, [0226]; *You*, [104].

56. A PDCCH occupies a group of resource elements in the control region. *You*, [114]. The number of resource elements allocated to a PDCCH is described by a parameter called the “aggregation level,” with a higher aggregation level corresponding to more resource elements. *You*, [116]; *Wong*, 7:26-31; When coverage is good, a low aggregation level may be sufficient; however, in case of poor coverage, a higher aggregation level may be needed so that more radio resources can be employed to ensure downlink transmission robustness. *You*, [116]; *Wong*, 7:31-33.
57. A plurality of PDCCHs can be configured for a control region. *You*, [107]. The DCIs transmitted in each of these PDCCHs may be directed to different UEs since each DCI is encoded with the identifier corresponding to respective UEs. *Id.* For example, the following figure illustrates that a subframe’s control region contains multiple PDCCHs transmitting DCIs for different UEs. *Id.*, Fig. 4. Each of the multiple PDCCHs occupies a different group of resource elements in the resource grid. In addition to the PDCCHs, the figure shows that the control region also contains other types of control

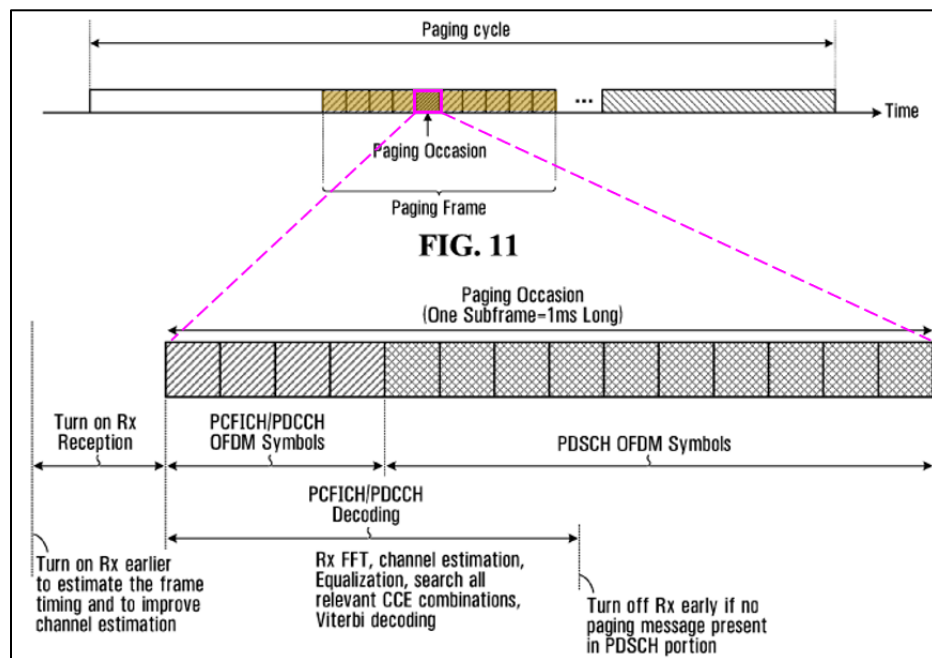
channels, such as physical control format indicator channel (PCFICH),
physical hybrid ARQ indicator channel (PHICH). *You*, [46].



You, Fig. 4.

58. Typically, in terms of receiving DCIs, a UE does not know which PDCCH(s) in the control region contain a DCI intended for it. *You*, [121]. Thus, the UE has to search through a set of PDCCHs in the control region by decoding each one to determine whether any one(s) of the PDCCH is encoded by an identifier associated with the UE. *You*, [117]. The PDCCHs in the set are also called “PDCCH candidates” to suggest that any of them may potentially be contain a DCI that is intended for the UE. *You*, [117]. And the set of PDCCH candidates is called a “PDCCH search space.” *You*, [117]; *Yum*, [0061]. If none of the PDCCH candidates in a current subframe’s control region actually contain any DCI encoded by the UE’s identifier, the UE will continue to decode and examine the PDCCH candidates in a next subframe’s control region.
59. Depending on the aggregation levels and certain other parameters, different sets of PDCCH candidates (i.e., different PDCCH search spaces) can be defined for a control region. *You*, [117], Table 9; These search spaces can be searched by all the UEs in a cell (called “common search space” or “CSS”) or only searched by a specific UE or UE group (called “UE specific search space”). The DCI associated with paging messages are usually transmitted on PDCCH candidates in the common search space. *Weng*, [243].

60. In the context of paging, the PDCCH is a control channel used for transmitting paging scheduling information, and the PDSCH is a data channel used for transmitting paging messages. *You*, [105] (Table 7), [178], [189], [193]. As illustrated below, at a subframe corresponding to a paging occasion, the UE initiates a reception (“Rx”) process to monitor (i.e., blind decodes) the PDCCH search space. *Id.*, [0257]-[0258]. If none of the PDCCH candidates in the search space has any DCI encoded with the UE’s ID, the UE turns off the Rx process and waits for the next paging occasion; however, if a DCI with the UE’s ID is detected, the UE obtains the paging message in a subsequent subframe by locating and decoding the corresponding PDSCH based on the DCI. *Id.*, [0260].



Weng, Figs. 11, 13.

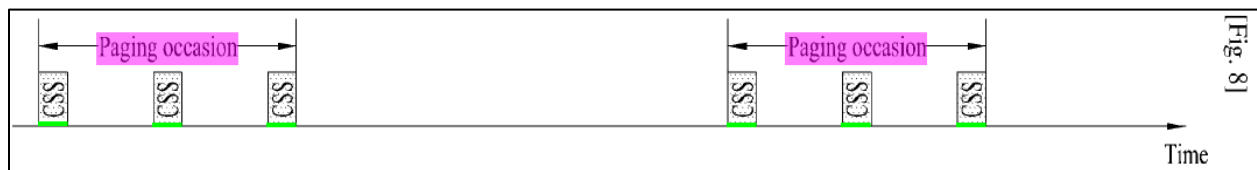
61. In summary of the above description, in the existing systems, the paging messages are transmitted on a PDSCH that is allocated in a data region of a subframe, and the DCI associated with the paging messages (that schedules when and where, i.e., the time and frequency location, the PDSCH appears in a subsequent frame) is transmitted on a corresponding PDCCH in a control region of a previous subframe. A UE can monitor a PDCCH search space to determine whether the DCI for the UE is actually transmitted on any of the PDCCH candidates. *You*, [121]. “Here, monitoring refers to attempting to decode each PDCCH in the corresponding search space” *Yum*, [0062]; *You*, [121]. Because “the UE does not know the location at which a PDCCH thereof is transmitted,” it “attempts to decode all PDCCHs . . . for each subframe until a PDCCH having an ID thereof is detected and this process is referred to as blind detection (or blind decoding (BD)).” *You*, [121]; *Yum*, [0062]. If none of the PDCCH candidates in a current subframe’s control region contain any DCI encoded with the UE’s identifier, the UE will continue to decode and examine the PDCCH candidates in a next subframe’s control region, and so on.

7. Coverage Enhancement (CE)

62. Conventional 4G/LTE provides a coverage enhancement (CE) mode in which a base station may repeat a transmission of a signal, such that a

corresponding UE may attempt repeated receptions to achieve an increased likelihood of successfully decoding the signal. *Webb*, 13:22-24, 14:3-15:11, 15:23-16:8, Fig. 6; *Lee*, [0061]-[0063]. This is particularly useful when the signal reception is weak, e.g., at the edge of a cell.

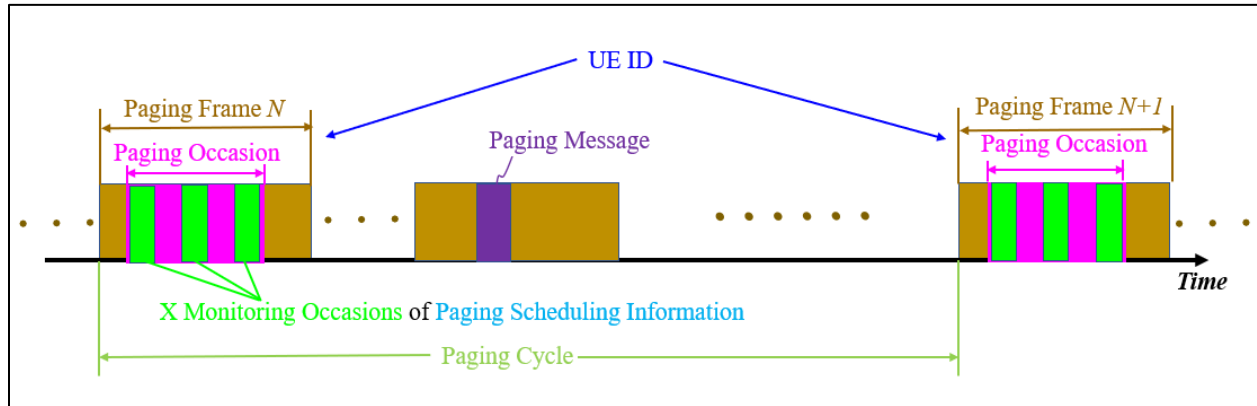
63. When applying the CE mode to paging, at each **paging occasion**, the same PDCCH may be repeatedly transmitted in a plurality of common search spaces (CSSs) over **a plurality of subframes**, respectively; accordingly, a UE may monitor the PDCCH CSSs in these **subframes** (i.e., **monitoring occasions**). *You*, [186]-[187], [195]-[196], [199]-[200].



You, Fig. 8.

8. Summary

64. I illustrate the above well-known 4G/LTE paging procedure in the drawings below. As shown, a UE uses a **UE ID** to determine **paging frames** and **paging occasions** in **paging cycles**; in each **paging occasion**, the UE monitors the **paging scheduling information** in **X monitoring occasions**, with $X > 1$ when CE mode is applied; and the UE locates the **paging messages** based on the **paging scheduling information**.

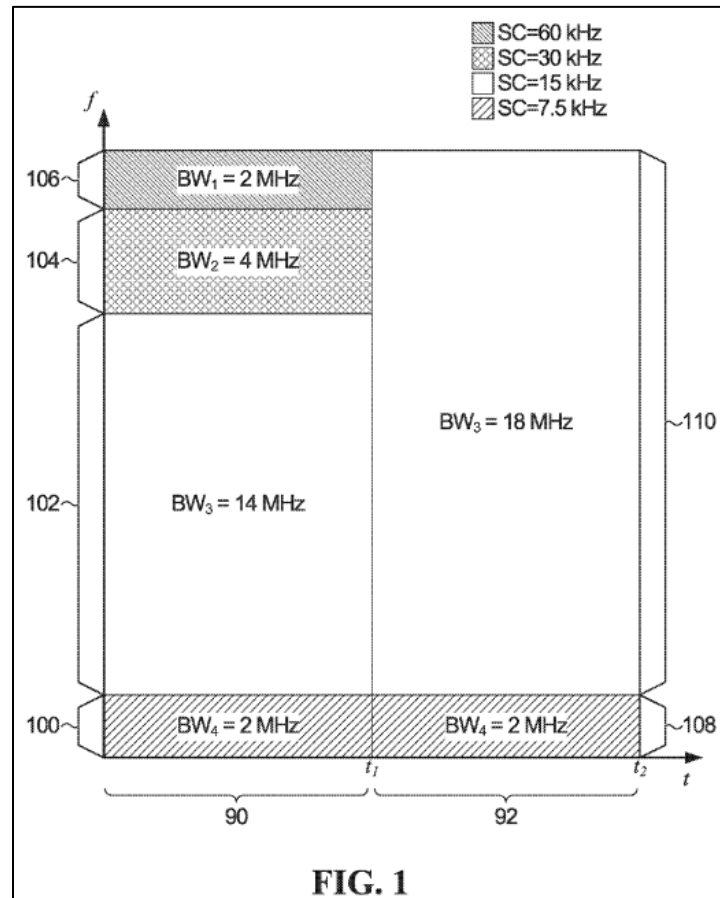


C. 5th Generation Wireless Networks / New Radio (5G/NR)

65. While the '767 patent was first filed in the U.S. in April 2018, 3GPP began its 5G standardization effort in 2015. *Parkvall*, [0009]. Unlike previous 2G, 3G and 4G systems, a wide range of frequency spectrum was proposed to be used in the 5G system, such as a low frequency band “up to 6 GHz,” a mid-frequency band “6-30 GHz”, and a high frequency band “above 30 GHz.” *Fwu*, [0033], [0040].
66. The planning stages for 5G standardization aimed for goals that included “higher density of mobile broadband users, and supporting device-to-device, ultra-reliable, and massive machine communications”, and “lower battery consumption, for better implementation of the Internet of things.” *Yi*, ¶41. Some ideas for the new radio access technology that were understood by a person of ordinary skill in the art (“POSA”) include reserving frequency resources for different subcarrier spacing, or assigning a different subcarrier spacing for each beam direction. *Yi*, [68], [71].

1. Flexible Numerology

67. The term “numerology” in the context of OFDM-based wireless communication was understood by a POSA to refer to a set of parameters that include “subcarrier spacing, a symbol length, a length of a cyclic prefix (CP), and so on.” *Liu913*, [0036]. In consideration of the wide range of possible frequency spectra in use based on the heterogeneous frequency spectrum allocations that may be licensed by government entities, the heterogeneous needs of use cases supported by the network, and the propagation environment, the 5G system was proposed to support “configurable numerology including subcarrier spacing and symbol duration.” *Fwu*, [0057]; *Schaich*, p. 1.
68. Researchers and engineers had proposed various numerology settings for the 5G system. For example, as shown below, during time period 90, an available bandwidth is divided between four subbands “BW” with 7.5, 15, 30, and 60 kHz subcarrier spacings, respectively; while during time period 92, a new division is used to obtain two subbands with differing subcarrier spacings. *Islam*, [0035], Fig. 1. It had been understood by a person of ordinary skill that each of these subcarrier spacings may correspond to a different OFDM symbol length because “different sub-carrier spacing may lead to different time durations for a symbol.” *Pelletier*, [0072].



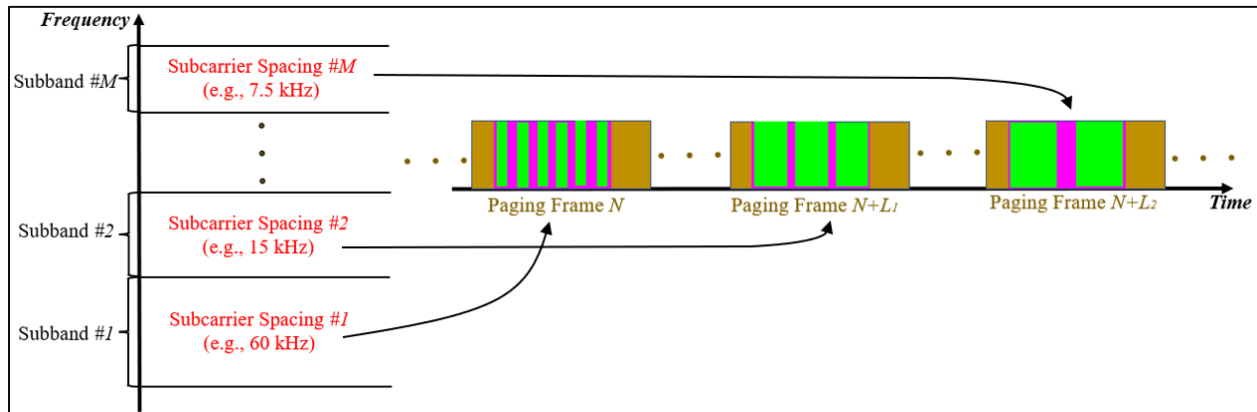
Islam, Fig. 1.

2. Various Frame Structures

69. It was understood by a POSA that a 4G LTE/LTE-A new radio access technology could be modified to have a flexible frame structure in which different frames have different numerologies, including different subcarrier spacings, and different time interval durations, under the control of a processor. *Parkvall*, [0013]–[0014]; *Yi*, [9]–[10], [33].
70. As discussed in Section VI.B.4, it was well known before the 5G era that different subcarrier spacings may result in different frame structures. Thus,

the flexible numerology in a 5G radio had been understood to mean that multiple frame structures may be used to schedule the downlink transmission/monitoring of DCI, e.g., paging scheduling information. *Yi*, [155]-[163] (Tables 1-3 respectively showing frame structures corresponding to 30, 15, and 60 kHz subcarrier spacings).

71. While the '767 patent tries to portray this flexibility as inventive, it already existed in the state of the art, including in exemplary prior art references *Liu*, *Schaich*, *Fwu*, *Pelletier*, etc. For example, as I illustrate below, *Liu* teaches that the “subband” used to transmit the **paging scheduling information** may change over time due to “frequency hopping.” *Liu*, [0053]-[0056]. Since different subbands may be assigned to different numerologies, *Islam*, [0035], the subband switch, and in turn the change of **subcarrier spacing**, changes the number and durations of the **monitoring occasions** in a **paging occasion**. *Liu*, Abstract, [0019], [0040]. This calls for the UE to determine the change of the **monitoring occasions** based on differing **subcarrier spacing** because otherwise it will have difficulty in receiving the **paging scheduling information**. *Id.*



VII. THE '767 PATENT

A. Alleged Invention of the '767 Patent in View of Prior Art

72. The '767 patent relates “to a method and a device for paging transmission in a communication system supporting multiple numerologies,” with “[t]he various numerologies refer[ring] to various subcarrier spacings, various symbol time lengths, various Cyclic Prefix (CP) lengths, etc.” '767 patent, 1:15-18, 1:34-37. The '767 patent “provides a solution[] which determines the transmission opportunities of paging according to the numerology employed by the paging.” *Id.*, 2:1-9. For example, claim 1 recites:

1. A method in a User Equipment (UE) for paging,
comprising:
monitoring a first signaling in X time intervals; and
receiving a first radio signal;
wherein X is a positive integer; the first signaling is used
for determining scheduling information for the first
radio signal;

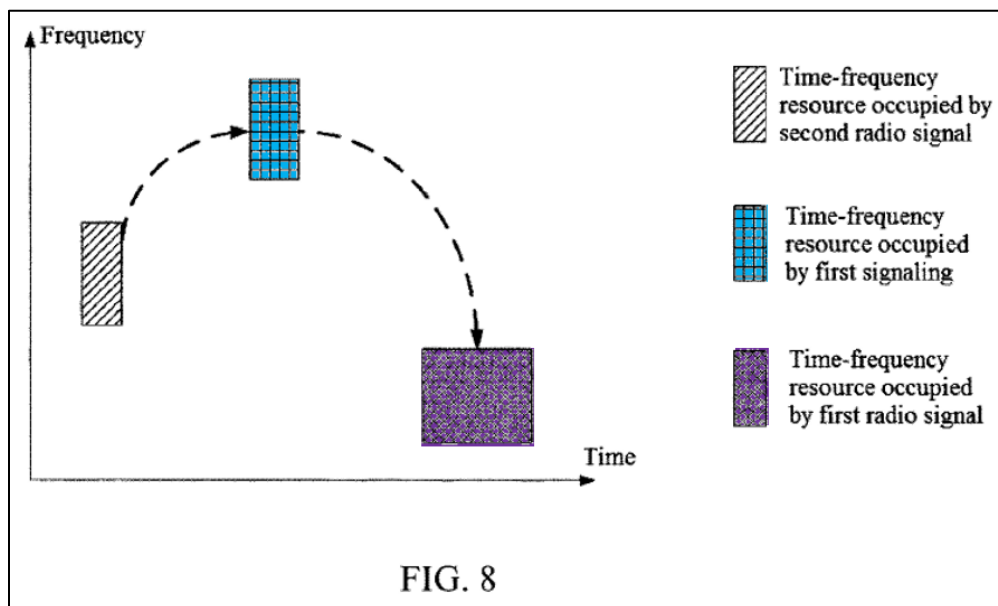
the scheduling information comprises at least one of
 {occupied time-frequency resource, adopted
 Modulation Coding Scheme (MCS), subcarrier
 spacing of subcarriers in occupied frequency
 domain resource};
the first radio signal carries a paging message;
the frequency domain resource used for transmitting the
 first signaling belongs to a first subband;
the first subband comprises a positive integer number of
 consecutive subcarriers in frequency domain; and
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.

Id., 23:2-20. The limitations of claim 1 can be grouped into the following
three concepts:

- (i) using a first signaling to schedule a paging message;
- (ii) monitoring the first signaling in X time intervals; and
- (iii) using the subcarrier spacing associated with the first signaling to
determine the X time intervals.

73. Concept (i) is illustrated in Figure 8. “In FIG. 8, the horizontal axis
represents time, the vertical axis represents frequency, . . . the rectangle
filled by cross lines represents a time-frequency resource occupied by the

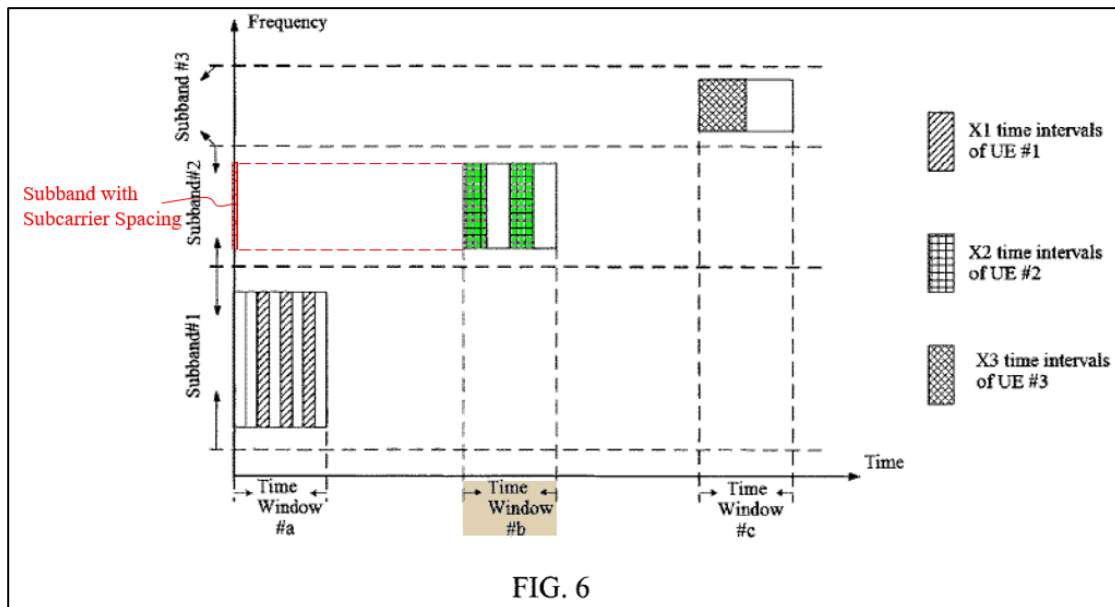
first signaling, the rectangle filled by crossed oblique lines represents a time-frequency resource occupied by the first radio signal, and the dotted arrow represents a specific usage relationship” in which “the first signaling is used for determining scheduling information for the first radio signal.” *Id.*, 19:54-64. The first signaling may be “a physical layer signaling,” such as “DCI” (i.e., downlink control information), and may be “transmitted through an NR-PDCCH” or “a PDCCH.” *Id.*, 20:8-14. The first radio signal, i.e., paging message, may be “transmitted through a PDSCH.” *Id.*, 20:18-19.



Id., Fig. 8.

74. Concept (ii) is illustrated in Figure 6, in which “each rectangle represents a time interval, the rectangles filled by oblique lines represent X1 time intervals monitored by a UE#1 in a time window #a, the rectangles filled by cross lines represent X2 time intervals monitored by a UE#2 in a time

window #b, the rectangles filled by crossed oblique lines represent X3 time intervals monitored by a UE#3 in a time window #c.” *Id.*, 17:47-54. For example, as shown in Figure 6, the UE#2 monitors a **first signaling** in **X2 time intervals**, and each of the **X2 time intervals** belongs to the **time window #b** in time domain. *Id.*, 17:55-56, 17:63-64.

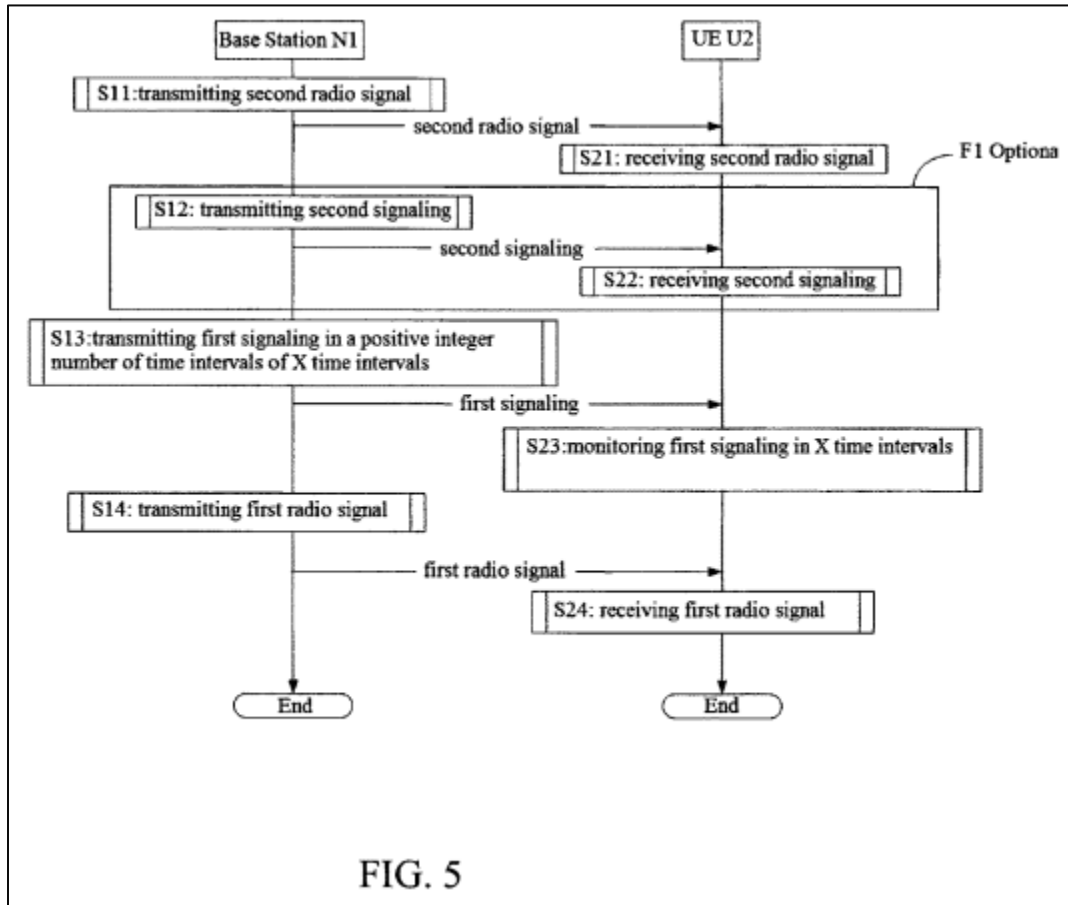


Id., Fig. 6.

75. Regarding concept (iii), the '767 patent describes that the **time window** associated with each UE in Figure 6 can be divided into **Y time intervals** (not shown in Figure 6), **Y** being a positive integer not smaller than **X**. *Id.*, 17:65-18:1. Moreover, for each UE, the subband of the frequency domain resource used for transmitting the **first signaling** “includes a positive integer number of consecutive subcarriers in frequency domain.” *Id.*, 17:58-59.

“Embodiment 5” (Figure 5) of the '767 patent repeats the claim language by

stating that “[a]t 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**.” *Id.*, 17:41-44.



Id., Fig. 5.

76. Moreover, “Embodiment 7” (Figure 7) of the ’767 patent describes that “[t]he **subcarrier spacing** of subcarriers included in the [respective] subband is used for determining **Y**” associated with the respective UE. *Id.*, 18:61-63. “The **feature ID** of the UE is used for determining the **X time intervals** in the **Y time intervals**,” and “the time length of each one of the **X time intervals** is

correlated to the subcarrier spacing of subcarriers.” *Id.*, 18:63-64, 19:7-10.

For example, Figure 7 shows a special case ($X=1$) for using the subcarrier spacing to determine the X time intervals. *Id.*, 18:49-54. Specifically, each UE (UE_a, UE_b, UE_c, or UE_d) is associated with a respective time window. *Id.*, 18:55-64. The subcarrier spacing associated with each UE is used to divide the respective time window into Y time intervals, and the feature ID of the UE is used to determine which one of the Y time intervals includes the $X=1$ time interval. *Id.* Moreover, the subcarrier spacing is used to determine the time length of the $X=1$ time interval. *Id.* This way, the subcarrier spacing is used to determine both the occasion (i.e., which Y time interval) and duration (i.e., time length) of each one of X time interval. *Id.*

	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

E.g., time window for Feature ID=b is divided into $Y=16$ time intervals, and the $X=1$ time interval is in the 7th time interval of the time window.

FIG. 7

Id., Fig. 7.³

77. The above three concepts, when viewed in light of the state of the art described in Section VI, simply describe a natural consequence of the evolution from 4G/LTE to 5G/NR. Specifically, concepts (i) and (ii) merely recite practices well-established in 4G/LTE:

- (i) paging (*supra*, Section VI.B.5); and
- (ii) monitoring PDCCH search space (*supra*, Section VI.B.6), with $X=1$ corresponding to the normal case when there is no coverage enhancement (CE), and $X>1$ corresponding to cases when CE is applied⁴.

78. Moreover, although the '767 patent alleges that concept (iii) arises from the shift from 4G/LTE's fixed subcarrier spacing to 5G/NR's flexible subcarrier

³ In Figure 7, the numbering of the " Y time intervals" starts from 0; thus, $Y=6$ corresponds to the 7th time interval.

⁴ Although the '767 patent's claims broadly recite the " X is a positive integer," its specification only describes an embodiment when $X=1$. '767 patent, 18:47-64 ("Embodiment 7"), Fig. 7. Nonetheless, in my opinion, a POSA would have understood that a UE in the CE mode monitors the same PDCCH search space multiple times.

spacing, it merely recites the well-known relationship between subcarrier spacing and an OFDM symbol-based frame structure. *Supra*, Sections VI.B.3–VI.B.4. Further, a POSA aware of the shift would have recognized the need of using this relationship to determine the timing for monitoring the PDCCH search space. *Supra*, Section VI.C.2; Therefore, none of the three concepts was new at the effective filing date of the '767 patent. Indeed, as explained below, all of them had already been disclosed by *You, Liu, and Mallick*.

B. The Challenged Claims

79. I understand that claims 1-20 of the '767 patent are being challenged in this proceeding. The claims are arranged as follows:
- Claims 1-5: Method for UE
 - Claims 6-10: Method for base station
 - Claims 11-15: UE device
 - Claims 16-20: Base station device
80. In my opinion, independent claim 11 is substantially similar to claim 1, except it is an apparatus claim directed to “[a] UE for paging,” and requires (1) “a first receiver module” to monitor a first radio signaling in X time intervals, and (2) “a second receiver module” to receive a first radio signal. In addition, claims 2-5 and claims 12-15 are also substantially identical.

81. The following table demonstrates the similarity between claims 1-5 and claims 11-15, with identical language italicized.

Claim 1	Claim 11
[1pre] <i>A method in a User Equipment (UE) for paging, comprising:</i>	[11pre] <i>A UE for paging, comprising:</i>
[1a] <i>monitoring a first signaling in X time intervals; and</i>	[11a] <i>a first receiver module, to monitor a first signaling in X time intervals; and</i>
[1b] <i>receiving a first radio signal;</i>	[11b] <i>a second receiver module, to receive a first radio signal;</i>
[1c] <i>wherein X is a positive integer;</i>	[11c] <i>wherein X is a positive integer;</i>
[1d] <i>the first signaling is used for determining scheduling information for the first radio signal;</i>	[11d] <i>the first signaling is used for determining scheduling information for the first radio signal;</i>
[1e] <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>	[11e] <i>the scheduling information comprises at least one of {occupied time-frequency resource, adopted MCS, subcarrier spacing of subcarriers in occupied frequency domain resource};</i>
[1f] <i>the first radio signal carries a paging message;</i>	[11f] <i>the first radio signal carries a paging message;</i>
[1g] <i>the frequency domain resource used for transmitting the first signaling belongs to a first subband;</i>	[11g] <i>the frequency domain resource used for transmitting the first signaling belongs to a first subband;</i>
[1h] <i>the first subband comprises a positive integer number of consecutive subcarriers in frequency domain; and</i>	[11h] <i>the first subband comprises a positive integer number of consecutive subcarriers in frequency domain; and</i>

Claim 1	Claim 11
[1i] <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>	[11i] <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>

Claim 2	Claim 12
[2a] <i>The method according to claim 1, wherein any one of the X time intervals belongs to a first time window in time domain;</i>	[12a] <i>The UE according to claim 11, wherein any one of the X time intervals belongs to a first time window in time domain;</i>
[2b] <i>the time length of the first time window is predefined;</i>	[12b] <i>the time length of the first time window is predefined;</i>
[2c] <i>the first time window is divided into Y time intervals;</i>	[12c] <i>the first time window is divided into Y time intervals;</i>
[2d] <i>the X time intervals are X time intervals of the Y time intervals, Y being a positive integer not smaller than X;</i>	[12d] <i>the X time intervals are X time intervals of the Y time intervals, Y being a positive integer not smaller than X;</i>
[2e] <i>the subcarrier spacing of subcarriers included in the first subband is used for determining Y; and</i>	[12e] <i>the subcarrier spacing of subcarriers included in the first subband is used for determining Y; and</i>
[2f] <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>	[12f] <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>

Claim 3	Claim 13
[3a] <i>The method according to claim 2, wherein the first time window belongs to one of Z time windows, Z being an integer greater than 1;</i>	[13a] <i>The UE according to claim 12, wherein the first time window belongs to one of Z time windows, Z being an integer greater than 1;</i>
[3b] <i>Z is predefined, or Z is configurable;</i>	[13b] <i>Z is predefined, or Z is configurable;</i>
[3c] <i>any two of the Z time windows have an equal time length; and</i>	[13c] <i>any two of the Z time windows have an equal time length; and</i>
[3d] <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>	[13d] <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>

Claim 4	Claim 14
[4a] <i>The method according to claim 1, further comprising: receiving a second radio signal;</i>	[14a] <i>The UE according to claim 11, wherein the first receiver module further receives a second radio signal;</i>
[4b] <i>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>	[14b] <i>the second radio signal is for determining at least one of {location of the first subband in frequency domain, subcarrier spacing of subcarriers included in the first subband}.</i>

Claim 5	Claim 15
[5a] <i>The method according to claim 1, further comprising: receiving a second signaling;</i>	[15a] <i>The UE according to claim 11, wherein the first receiver module further receives a second signaling;</i>

Claim 5	Claim 15
[5b] wherein <i>the second signaling is used for determining Q subbands, Q being a positive integer;</i>	[15b] <i>the second signaling is for determining Q subbands, Q being a positive integer;</i>
[5c] <i>the first subband belongs to one of the Q subbands;</i>	[15c] <i>the first subband belongs to one of the Q subbands;</i>
[5d] <i>any one of the Q subbands comprises a positive integer number of consecutive subcarriers; and</i>	[15d] <i>any one of the Q subbands comprises a positive integer number of consecutive subcarriers; and</i>
[5e] <i>the feature ID of the monitor of the first signaling is used for determining the first subband in the Q subbands.</i>	[15e] <i>the feature ID of the monitor of the first signaling is used for determining the first subband in the Q subbands.</i>

82. Independent claim 16 is substantially similar to claim 6, except it is an apparatus claim directed to a base station for paging, and requires (1) “a first transmitter module” to transmit a first signaling in a positive integer number of time intervals of X time intervals, and (2) “a second transmitter module” to transmit a first radio signal.

83. The following table demonstrates the similarity between claims 6-10 and claims 16-20, with identical language italicized.

Claim 6	Claim 16
[6pre] <i>A method in a base station for paging, comprising:</i>	[16pre] <i>A base station for paging, comprising:</i>

Claim 6	Claim 16
[6a] transmitting a first signaling in a positive integer number of time intervals of X time intervals; and	[16a] a first transmitter module, to transmit a first signaling in a positive integer number of time intervals of X time intervals; and
[6b] transmitting a first radio signal;	[16b] a second transmitter module, to transmit a first radio signal;
[6c] wherein X is a positive integer;	[16c] wherein X is a positive integer;
[6d] the first signaling is used for determining scheduling information for the first radio signal;	[16d] the first signaling is used for determining scheduling information for the first radio signal;
[6e] the scheduling information comprises at least one of {occupied time-frequency resource, adopted MCS, subcarrier spacing of subcarriers in occupied frequency domain resource};	[16e] the scheduling information comprises at least one of {occupied time-frequency resource, adopted MCS, subcarrier spacing of subcarriers in occupied frequency domain resource};
[6f] the first radio signal carries a paging message;	[16f] the first radio signal carries a paging message;
[6g] the frequency domain resource used for transmitting the first signaling belongs to a first subband;	[16g] the frequency domain resource used for transmitting the first signaling belongs to a first subband;
[6h] the first subband comprises a positive integer number of consecutive subcarriers in frequency domain; and	[16h] the first subband comprises a positive integer number of consecutive subcarriers in frequency domain; and
[6i] 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.	[16i] 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.

Claim 7	Claim 17
[7a] <i>The method according to claim 6, wherein any one of the X time intervals belongs to a first time window in time domain;</i>	[17a] <i>The base station according to claim 16, wherein any one of the X time intervals belongs to a first time window in time domain;</i>
[7b] <i>the time length of the first time window is predefined;</i>	[17b] <i>the time length of the first time window is predefined;</i>
[7c] <i>the first time window is divided into Y time intervals;</i>	[17c] <i>the first time window is divided into Y time intervals;</i>
[7d] <i>the X time intervals are X time intervals of the Y time intervals, Y being a positive integer not smaller than X;</i>	[17d] <i>the X time intervals are X time intervals of the Y time intervals, Y being a positive integer not smaller than X;</i>
[7e] <i>the subcarrier spacing of subcarriers included in the first subband is used for determining Y; and</i>	[17e] <i>the subcarrier spacing of subcarriers included in the first subband is used for determining Y; and</i>
[7f] <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>	[17f] <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>

Claim 8	Claim 18
[8a] <i>The method according to claim 7, wherein the first time window belongs to one of Z time windows, Z being an integer greater than 1;</i>	[18a] <i>The base station according to claim 17, wherein the first time window belongs to one of Z time windows, Z being an integer greater than 1;</i>

Claim 8	Claim 18
[8b] <i>Z is predefined, or Z is configurable;</i>	[18b] <i>Z is predefined, or Z is configurable;</i>
[8c] <i>any two of the Z time windows have an equal time length; and</i>	[18c] <i>any two of the Z time windows have an equal time length; and</i>
[8d] <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>	[18d] <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>

Claim 9	Claim 19
[9a] <i>The method according to claim 6, further comprising: transmitting a second radio signal;</i>	[19a] <i>The base station according to claim 16, wherein the first transmitter module further transmits a second radio signal;</i>
[9b] <i>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>	[19b] <i>the second radio signal is for determining at least one of {location of the first subband in frequency domain, subcarrier spacing of subcarriers included in the first subband}.</i>

Claim 10	Claim 20
[10a] <i>The method according to claim 6, further comprising: transmitting a second signaling;</i>	[20a] <i>The base station according to claim 16, wherein the first transmitter module further transmits a second signaling;</i>
[10b] <i>wherein the second signaling is used for determining Q subbands, Q being a positive integer;</i>	[20b] <i>the second signaling is for determining Q subbands, Q being a positive integer;</i>

Claim 10	Claim 20
[10c] <i>the first subband belongs to one of the Q subbands;</i>	[20c] <i>the first subband belongs to one of the Q subbands;</i>
[10d] <i>any one of the Q subbands comprises a positive integer number of consecutive subcarriers; and</i>	[20d] <i>any one of the Q subbands comprises a positive integer number of consecutive subcarriers; and</i>
[10e] <i>the feature ID of the monitor of the first signaling is used for determining the first subband in the Q subbands.</i>	[20e] <i>the feature ID of the monitor of the first signaling is used for determining the first subband in the Q subbands.</i>

84. Claims 1-5 and 6-10 recite corresponding methods performed by a UE and base station, respectively. The following table demonstrates the similarity between claims 1-5 and claims 6-10, with identical language italicized.

Claim 1	Claim 6
[1pre] <i>A method in a User Equipment (UE) for paging, comprising:</i>	[6pre] <i>A method in a base station for paging, comprising:</i>
[1a] <i>monitoring a first signaling in X time intervals; and</i>	[6a] <i>transmitting a first signaling in a positive integer number of time intervals of X time intervals; and</i>
[1b] <i>receiving a first radio signal;</i>	[6b] <i>transmitting a first radio signal;</i>
[1c] <i>wherein X is a positive integer;</i>	[6c] <i>wherein X is a positive integer;</i>
[1d] <i>the first signaling is used for determining scheduling information for the first radio signal;</i>	[6d] <i>the first signaling is used for determining scheduling information for the first radio signal;</i>

Claim 1	Claim 6
[1e] <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>	[6e] <i>the scheduling information comprises at least one of {occupied time-frequency resource, adopted MCS, subcarrier spacing of subcarriers in occupied frequency domain resource};</i>
[1f] <i>the first radio signal carries a paging message;</i>	[6f] <i>the first radio signal carries a paging message;</i>
[1g] <i>the frequency domain resource used for transmitting the first signaling belongs to a first subband;</i>	[6g] <i>the frequency domain resource used for transmitting the first signaling belongs to a first subband;</i>
[1h] <i>the first subband comprises a positive integer number of consecutive subcarriers in frequency domain; and</i>	[6h] <i>the first subband comprises a positive integer number of consecutive subcarriers in frequency domain; and</i>
[1i] <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>	[6i] <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>

Claim 2	Claim 7
[2a] <i>The method according to claim 1, wherein any one of the X time intervals belongs to a first time window in time domain;</i>	[7a] <i>The method according to claim 6, wherein any one of the X time intervals belongs to a first time window in time domain;</i>
[2b] <i>the time length of the first time window is predefined;</i>	[7b] <i>the time length of the first time window is predefined;</i>
[2c] <i>the first time window is divided into Y time intervals;</i>	[7c] <i>the first time window is divided into Y time intervals;</i>

Claim 2	Claim 7
[2d] <i>the X time intervals are X time intervals of the Y time intervals, Y being a positive integer not smaller than X;</i>	[7d] <i>the X time intervals are X time intervals of the Y time intervals, Y being a positive integer not smaller than X;</i>
[2e] <i>the subcarrier spacing of subcarriers included in the first subband is used for determining Y; and</i>	[7e] <i>the subcarrier spacing of subcarriers included in the first subband is used for determining Y; and</i>
[2f] <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>	[7f] <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>

Claim 3	Claim 8
[3a] <i>The method according to claim 2, wherein the first time window belongs to one of Z time windows, Z being an integer greater than 1;</i>	[8a] <i>The method according to claim 7, wherein the first time window belongs to one of Z time windows, Z being an integer greater than 1;</i>
[3b] <i>Z is predefined, or Z is configurable;</i>	[8b] <i>Z is predefined, or Z is configurable;</i>
[3c] <i>any two of the Z time windows have an equal time length; and</i>	[8c] <i>any two of the Z time windows have an equal time length; and</i>
[3d] <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>	[8d] <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>

Claim 4	Claim 9
[4a] <i>The method according to claim 1, further comprising: receiving a second radio signal;</i>	[9a] <i>The method according to claim 6, further comprising: transmitting a second radio signal;</i>
[4b] <i>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>	[9b] <i>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>

Claim 5	Claim 10
[5a] <i>The method according to claim 1, further comprising: receiving a second signaling;</i>	[10a] <i>The method according to claim 6, further comprising: transmitting a second signaling;</i>
[5b] <i>wherein the second signaling is used for determining Q subbands, Q being a positive integer;</i>	[10b] <i>wherein the second signaling is used for determining Q subbands, Q being a positive integer;</i>
[5c] <i>the first subband belongs to one of the Q subbands;</i>	[10c] <i>the first subband belongs to one of the Q subbands;</i>
[5d] <i>any one of the Q subbands comprises a positive integer number of consecutive subcarriers; and</i>	[10d] <i>any one of the Q subbands comprises a positive integer number of consecutive subcarriers; and</i>
[5e] <i>the feature ID of the monitor of the first signaling is used for determining the first subband in the Q subbands.</i>	[10e] <i>the feature ID of the monitor of the first signaling is used for determining the first subband in the Q subbands.</i>

85. The following table demonstrates the similarity between claims 1-5 and claims 16-20, with identical language italicized.

Claim 1	Claim 16
[1pre] <i>A method in a User Equipment (UE) for paging, comprising:</i>	[16pre] <i>A base station for paging, comprising:</i>
[1a] <i>monitoring a first signaling in X time intervals; and</i>	[16a] <i>a first transmitter module, to transmit a first signaling in a positive integer number of time intervals of X time intervals; and</i>
[1b] <i>receiving a first radio signal;</i>	[16b] <i>a second transmitter module, to transmit a first radio signal;</i>
[1c] <i>wherein X is a positive integer;</i>	[16c] <i>wherein X is a positive integer;</i>
[1d] <i>the first signaling is used for determining scheduling information for the first radio signal;</i>	[16d] <i>the first signaling is used for determining scheduling information for the first radio signal;</i>
[1e] <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>	[16e] <i>the scheduling information comprises at least one of {occupied time-frequency resource, adopted MCS, subcarrier spacing of subcarriers in occupied frequency domain resource};</i>
[1f] <i>the first radio signal carries a paging message;</i>	[16f] <i>the first radio signal carries a paging message;</i>
[1g] <i>the frequency domain resource used for transmitting the first signaling belongs to a first subband;</i>	[16g] <i>the frequency domain resource used for transmitting the first signaling belongs to a first subband;</i>
[1h] <i>the first subband comprises a positive integer number of consecutive subcarriers in frequency domain; and</i>	[16h] <i>the first subband comprises a positive integer number of consecutive subcarriers in frequency domain; and</i>

Claim 1	Claim 16
[1i] <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>	[16i] <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>

Claim 2	Claim 17
[2a] <i>The method according to claim 1, wherein any one of the X time intervals belongs to a first time window in time domain;</i>	[17a] <i>The base station according to claim 16, wherein any one of the X time intervals belongs to a first time window in time domain;</i>
[2b] <i>the time length of the first time window is predefined;</i>	[17b] <i>the time length of the first time window is predefined;</i>
[2c] <i>the first time window is divided into Y time intervals;</i>	[17c] <i>the first time window is divided into Y time intervals;</i>
[2d] <i>the X time intervals are X time intervals of the Y time intervals, Y being a positive integer not smaller than X;</i>	[17d] <i>the X time intervals are X time intervals of the Y time intervals, Y being a positive integer not smaller than X;</i>
[2e] <i>the subcarrier spacing of subcarriers included in the first subband is used for determining Y; and</i>	[17e] <i>the subcarrier spacing of subcarriers included in the first subband is used for determining Y; and</i>
[2f] <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>	[17f] <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>

Claim 3	Claim 18
[3a] <i>The method according to claim 2, wherein the first time window belongs to one of Z time windows, Z being an integer greater than 1;</i>	[18a] <i>The base station according to claim 17, wherein the first time window belongs to one of Z time windows, Z being an integer greater than 1;</i>
[3b] <i>Z is predefined, or Z is configurable;</i>	[18b] <i>Z is predefined, or Z is configurable;</i>
[3c] <i>any two of the Z time windows have an equal time length; and</i>	[18c] <i>any two of the Z time windows have an equal time length; and</i>
[3d] <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>	[18d] <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>

Claim 4	Claim 19
[4a] <i>The method according to claim 1, further comprising: receiving a second radio signal;</i>	[19a] <i>The base station according to claim 16, wherein the first transmitter module further transmits a second radio signal;</i>
[4b] <i>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>	[19b] <i>the second radio signal is for determining at least one of {location of the first subband in frequency domain, subcarrier spacing of subcarriers included in the first subband}.</i>

Claim 5	Claim 20
[5a] <i>The method according to claim 1, further comprising: receiving a second signaling;</i>	[20a] <i>The base station according to claim 16, wherein the first transmitter module further transmits a second signaling;</i>
[5b] <i>wherein the second signaling is used for determining Q subbands, Q being a positive integer;</i>	[20b] <i>the second signaling is for determining Q subbands, Q being a positive integer;</i>
[5c] <i>the first subband belongs to one of the Q subbands;</i>	[20c] <i>the first subband belongs to one of the Q subbands;</i>
[5d] <i>any one of the Q subbands comprises a positive integer number of consecutive subcarriers; and</i>	[20d] <i>any one of the Q subbands comprises a positive integer number of consecutive subcarriers; and</i>
[5e] <i>the feature ID of the monitor of the first signaling is used for determining the first subband in the Q subbands.</i>	[20e] <i>the feature ID of the monitor of the first signaling is used for determining the first subband in the Q subbands.</i>

86. Similarly, claims 11-15 and 16-20 recite corresponding features in a UE and a base station, respectively.

C. Prosecution History

87. I understand that the application that issued as the '767 patent was filed on April 18, 2018. It claims priority to Chinese Application No. 201710255811.X, filed on April 19, 2017. Ex. 1004, 92, 99.

88. I have reviewed the prosecution history (Ex. 1004) of the '767 patent. I understand that *You*, *Liu*, and *Mallick* were not considered by the Examiner

during prosecution. *See* Ex. 1001, 1-2; Ex. 1004. As explained below, I believe that *You* (Ex. 1005) in view of *Liu* (Ex. 1006) alone, or further in view of *Mallick* (Ex. 1007), teaches all the claims in the '767 patent.

D. Claim Construction

89. I have been instructed that the “intrinsic record” includes the patent itself, including the claims, description, and figures (Ex. 1001), and the patent’s prosecution history—i.e., the record of proceedings at the U.S. Patent and Trademark Office (“Patent Office”) concerning the patent (Ex. 1004). I understand that, like the claims and written description, the prosecution history provides evidence to a person of ordinary skill in the art of how the inventor intended his patent to be understood, and how the Patent Office understood the patent. I understand that the inventor is permitted to apply a special definition to the terms or to limit the scope of claim terms in his patent claims, which may differ from the term’s plain and ordinary meaning. That special definition or limitation on scope may be provided in the patent’s written description, the patent’s prosecution history, or both.
90. I understand that claim interpretation may also be informed by “extrinsic evidence” (that is, evidence outside of the patent record itself). I have been informed that extrinsic evidence may include dictionaries, technical

treatises, and other materials evidencing the meaning of a claim term and the understanding held by a POSITA in the relevant time period.

91. I have been asked for purposes of this declaration to apply the plain and ordinary meaning of the claim terms as they would have been understood by a person of ordinary skill in the art at the earliest claimed priority date of the '767 patent.
92. I understand that no claim term's construction is in dispute at this time. Based on my review of these materials and my personal knowledge and experience, I have considered each term of the '767 patent as it would have been understood by a person of ordinary skill in the art at the earliest claimed priority date of April 19, 2017.

VIII. LEVEL OF ORDINARY SKILL IN THE ART

93. In rendering the opinions set forth in this declaration, I have been asked to consider the '767 patent's claims and the prior art through the eyes of a person of ordinary skill in the art (which I may also refer to as "one skilled in the art," "skilled artisan," "POSA," or similar variation). I have considered factors such as the educational level and years of experience of those working in the pertinent art, the types of problems encountered in the art, the teachings of the prior art, patents and publications of other persons or companies, and the sophistication of the technology.

94. Taking the factors described in the Legal Standards – Level of Ordinary Skill section into consideration, it is my opinion that a person of ordinary skill in the art pertinent to the '767 patent (April 19, 2017) would have had at least a master's degree in electrical engineering or a related field, and 5 years of work/research experience in the field of wireless networking. Additional education beyond a master's degree can make up for a lack of work and/or research experience, and more than 5 years of relevant work and/or research experience can compensate for a lesser level of education.
95. I was at least a person of ordinary skill in the art as of April 19, 2017.

IX. ANALYSIS OF GROUNDS OF UNPATENTABILITY

96. In my opinion, the challenged claims are unpatentable for the reasons explained below.

A. Claims 1, 4-6, 9-11, 14-16, 19, and 20 Are Obvious Over *You* and *Liu* (Ground 1)

1. Overview of *You*

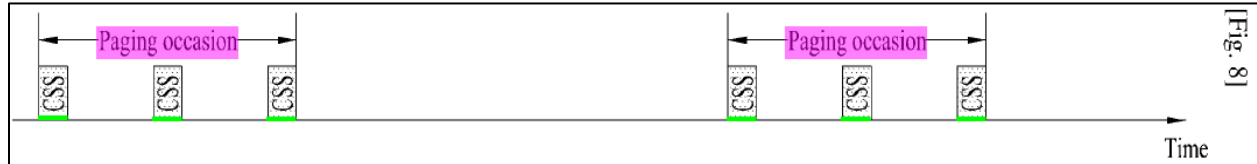
97. *You* discloses “a method for transmitting or receiving downlink control information” in LTE or LTE-Advanced (LTE-A) systems. *You*, [1], [51]. In particular, the method can be used in “machine type communication (MTC)” (i.e., machine-to-machine communication) that involves “exchange of information between a machine and an eNB [base station] without involving persons or with minimal human intervention.” *Id.*, [173]. Here, the machine

(i.e., UE) can be a smartphone, a tablet PC, a meter, a surveillance camera, a vending machine, a wearable device, etc., located in diverse environments. *Id.*, [2], [173], [179]. When “located in a place such as a basement, a warehouse, and mountain regions which the coverage of a typical eNB does not reach,” “the MTC UE has difficulty in receiving” downlink transmissions such as “the PDCCH, the PDSCH, etc.” *Id.*, [173]-[174]. To solve this problem, *You* “proposes that the eNB apply a coverage enhancement scheme” to repeat the transmission of a signal in multiple subframes respectively, so that a UE can effectively receive the signal. *Id.*, [174]; *see also id.*, [178], [182]-[183]. For example, to repeat the transmission of an MTC PDCCH (referred to as “M-PDCCH”), “a search space for reception of the same M-PDCCH may be configured in each of one or more [consecutive or non-consecutive] downlink subframes.” *Id.*, [177], [185].

98. Figure 8 of *You* discloses a method of applying the coverage enhancement scheme to paging message scheduling. *Id.*, [187]-[188]. Specifically, the PDCCH used in MTC is referred to as M-PDCCH. *Id.*, [177]. *You* discloses that “a paging occasion may be defined as an interval where a UE monitors a paging M-PDCCH.” *Id.*, [199]. In case of no coverage enhancement, a paging occasion only includes one such M-PDCCH search space (i.e., one

downlink subframe); whereas in case of coverage enhancement, a paging occasion includes multiple repetitions of the M-PDCCH search space over multiple downlink subframes respectively. *Id.*, [186]-[187].

99. Similar to concept (ii) in the '767 patent (*supra*, Section VII.A), *You* discloses that “a UE can monitor a common search space (CSS)” in “multiple CSS monitoring opportunities within a paging occasion” *Id.*, [196]. And similar to concept (i) in the '767 patent (*supra*, Section VII.A), *You* discloses that “[i]f the paging M-PDCCH . . . is received within” the paging occasion, “the UE may receive a PDSCH carrying the corresponding paging message.” *Id.*, [199].



Id., Fig. 8.

100. *You* discloses that not all UEs require the same level of coverage enhancement. *Id.*, [179]. “For example, since devices such as sensor and meter have low mobility and are likely to be located in a shaded area . . . ,” they “may need high CE,” i.e., more repetitions of the same M-PDCCH. *Id.* In contrast, “wearable devices such as smart watch may have mobility and are likely to be located in a place not a shaded area,” so low CE or no CE may be sufficient. *Id.*

101. In my opinion, *You* is analogous art to the '767 patent because *You*, like the '767 patent, discloses transmission/monitoring schemes in wireless communication systems relating to, for example, paging transmission. '767 patent, Abstract, 1:15-89, 3:7-14. In particular, *You* discloses methods of configuring "M-PDCCH CSS for paging scheduling," each CSS being "within an interval where a UE monitors [the] M-PDCCH." *You*, [185], [188]-[189]. This is just like the '767 patent's disclosure about monitoring the "first signaling" (i.e., paging scheduling information) in "X time intervals." '767 patent, Abstract, 2:20-32.

2. Overview of *Liu*

102. In my opinion, *Liu* attempts to solve the same problem as the '767 patent. Like the '767 patent, *Liu* recognizes that the DCI transmission/reception solution employed by earlier networks will not work properly in 5G/NR networks because of the different numerologies supported by 5G/NR networks.

'767 patent	<i>Liu</i>
"Under the 5G NR, a network supports <u>different numerologies</u> , thus, a given time length, for example, 1 millisecond, probably includes multiple	"Especially, in the NR network , <u>different numerologies</u> will coexist in the same carrier and a mini-slot will be introduced to carry Ultra-reliable low

<u>basic scheduling units</u> (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.” ’767 patent, 1:58-64 (emphases added).	latency communication (URLLC) traffic However, with the current DCI monitoring solution in LTE, it cannot support the DCI monitoring occasion change due to numerology and <u>scheduling unit size</u>.” <i>Liu</i>, [0003]-[0005] (emphases added).
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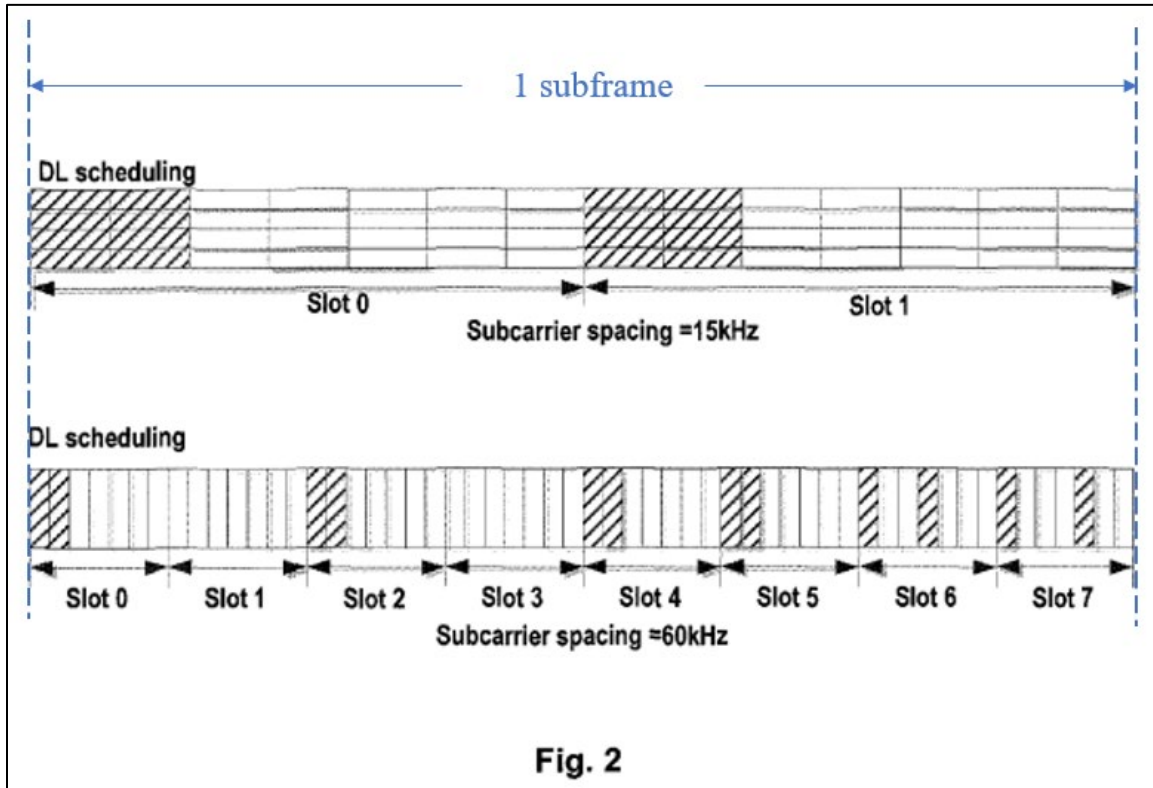
103. And, in my opinion, *Liu* provides the same solution as the ’767 patent.

Supra, Section VII.A (concept (iii) in the ’767 patent). In particular, *Liu* provides the same solution as concept (iii) of the ’767 patent: it enables a UE to determine “monitoring occasion[s]” based on “numerology.”

’767 patent	<i>Liu</i>
“[T]he present disclosure provides a solution, which determines the transmission opportunities of paging according to the numerology	“[T]he terminal device may monitor the transmitted DCI based on the received DCI configuration parameter,” wherein “the DCI configuration parameter comprises . . . a numerology

employed by the paging” ’767 patent, 2:1-9 (emphasis added).	to be used. . . .” <i>Liu</i> , [0040] (emphasis added), [0044] (emphasis added).
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104. Specifically, *Liu* explains that the 5G/NR system supports different numerologies, which “use different transmission parameters, for example different subcarrier spacings.” *Liu*, [0045]. For example, in addition to supporting the 15 kHz subcarrier spacing used in 4G/LTE, a 5G/NR system may also support a 60 kHz subcarrier spacing. *Id.*, Fig. 2. “[F]or 15 kHz subcarrier spacing, its symbol will have a time length four times as that for 60 kHz subcarrier spacing.” *Id.*, [0045]. Relatedly, with 15 kHz subcarrier spacing, a subframe is divided into two slots, whereas with 60 kHz subcarrier spacing, a subframe is divided into eight slots. *Id.*, Fig. 2; *supra*, Sections VI.B.4, VI.C. Thus, the symbol and slot durations depend on the subcarrier spacing. *Liu*, [0005], [0019], [0040].



Id., Fig. 2.⁵

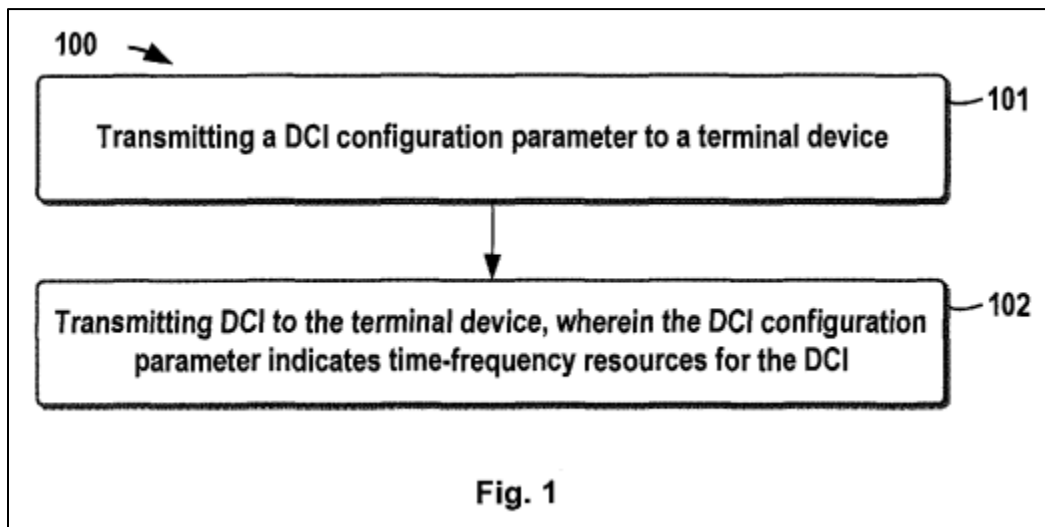
⁵ Although not directly stated by *Liu*, it is my opinion that a POSA reading *Liu* would have understood that the time window shown in *Liu*'s Figure 2 corresponds to one subframe. This is because the known 4G/LTE system uses a 15 kHz subcarrier spacing and the associated subframe includes two slots. *Supra*, Sections VI.B.3 ("Frame Structure") and II.B.4 ("Subcarrier Spacing"). Moreover, *Liu913*, with the same inventors as *Liu*, states that "a numerology for a subcarrier spacing of 15KHz may include 14 symbols" and "[a] numerology for a subcarrier spacing of 30KHz may include 28 symbols in one subframe." *Liu913*, ¶ [0036]. It follows

105. *Liu* discloses that the DCI can be transmitted per slot or per multi-slots. *Id.*, [0048]-[0049]. Therefore, a slot is also called a “scheduling unit” for the DCI transmission. *Id.*, [0005], [0019], [0040]. Changing the subcarrier spacing would change the symbol size and the slot size (i.e., scheduling unit size), which in turn changes the DCI monitoring occasions. *Id. Liu* recognizes that this makes it difficult for a UE to receive the DCI. *Id.*
106. *Liu* proposes a method to solve this problem. As shown in Figure 1, in step 101, a base station first transmits a DCI configuration parameter to a UE, before the actual DCI is transmitted. *Id.*, [0019], [0043], “[T]he DCI configuration parameter indicates time-frequency resources for a following DCI [transmission]” and may include information specifying:
- “a numerology to be used” for the DCI transmission;
 - “DCI occurrence occasions,” i.e., the periodicity or aperiodic pattern of the DCI occurrences over the slots;
 - “a duration for a single DCI,” namely, the duration for each DCI occurrence;
 - “a valid duration for the DCI configuration parameter”;

that a numerology for a subcarrier spacing of 60 kHz may include 56 symbols in one subframe, as shown in Figure 2 of *Liu*.

- a “frequency domain resource unit,” namely, the subband location and bandwidth used for the DCI transmission; and
- a “frequency hopping pattern.”

Id., [0019], [0043]-[0044], [0053]; *see also id.*, [0045]-[0052], [0054]-[0056]. Then, “in step 102, the DCI can be transmitted to the terminal device,” which “may learn the time-frequency resource for the DCI from the DCI configuration parameter and monitor the DCI within the time-frequency resource.” *Liu*, [0057].



Id., Fig. 1.

3. Rationale for Combining *You* and *Liu*

107. As discussed in Sections IX.A.1 and IX.A.2, *You* discloses a method for a UE to monitor a paging M-PDCCH configured over one or more subframes, and *Liu* provides a solution for a UE to monitor DCI configured over one or

more slots and dynamically determine the DCI monitoring occasions based on numerology. For the following reasons, a POSA would have been motivated to modify *You*'s subframe-level M-PDCCH/DCI monitoring to slot level based on *Liu*'s teachings, and would have had a reasonable expectation of success for doing so.

a. A POSA would have been motivated to combine the teachings of *You* and *Liu*

108. In my opinion, a variety of reasons would have motivated a POSA to combine the teachings of *You* and *Liu*.
109. First, *You* and *Liu* are in the same field of endeavor. On one hand, *You* explains that “[t]he control information transmitted through the PDCCH will be referred to as downlink control information (DCI)” and is directed to methods for transmitting and receiving the DCI. *You*, [104], [1], Title. *You* discloses that the DCI can include information (e.g., “RB allocation” and “modulation coding scheme (MCS)”) that is used “for paging message scheduling.” *Id.*, [188], [104]. On the other hand, *Liu* provides “methods and apparatuses for downlink control information (DCI) transmission and receiving.” *Liu*, [0019]; *see also id.*, Title, Abstract. *Liu* discloses that the DCI may include “scheduling information” such as “information of MCS” and “information of resource allocation.” *Id.*, [0083], [0085]. Therefore, *You* and *Liu* both pertain to transmission and reception of the same type of DCI.

A POSA working in this field would have been interested in both references and considered their teachings..

110. Moreover, *You* and *Liu* are pertinent to the same particular problem in M-PDCCH/DCI transmission and reception — monitoring M-PDCCH/DCI in one or more time intervals. Specifically, *You* discloses a method for a UE to monitor paging M-PDCCH/DCI in one or more subframes that are within a paging occasion. *You*, [185], [199], Fig. 8. And *Liu* discloses a method for a UE to monitor DCI in one or more slots that are within “a valid duration for the DCI configuration parameter.” *Liu*, [0044], [0046], [0048]. *Liu* further explains that “DCI monitoring occasions” may be flexibly configured at slot level and provides a solution to determine the DCI monitoring occasion change caused by numerology change. *Id.*, [0019], [0040], [0048], Abstract. Thus, In my opinion, *Liu* logically would have commended itself to a POSA’s attention in considering *You*’s problem of configuring the M-PDCCH/DCI monitoring occasions. In particular, In my opinion, a POSA would have been motivated by *Liu*’s teachings to make *You*’s M-PDCCH/DCI monitoring occasions flexibly configurable based on numerologies, so that it can be used in the new 5G/NR system.
111. Moreover, there are abundant teachings, suggestions, or motivations that would have led a POSA to combine the teachings of *You* and *Liu*. In my

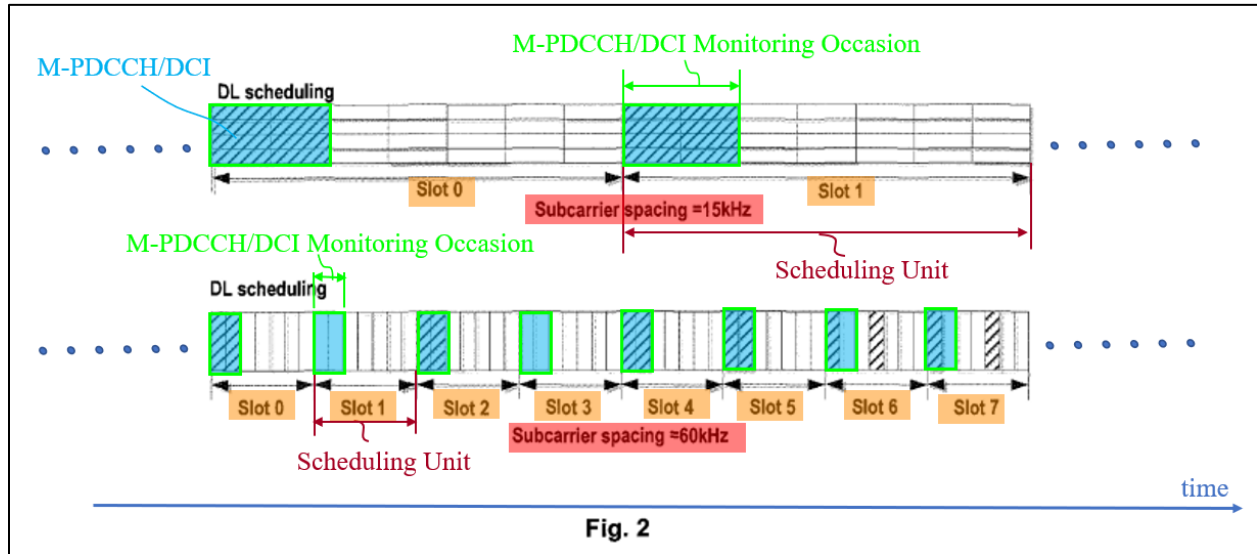
opinion, *Liu* is directed at solving problems caused by the movement to 5G/NR in the context of *You*. For example, *You* discloses that a “UE may use discontinuous reception (DRX) in an idle mode to reduce power consumption” and “monitors only one paging occasion per DRX cycle.” *You*, [192]. Likewise, *Liu* suggests that its DCI monitoring method can be applied to the “on duration of the discontinuous reception (DRX) active state.” *Liu*, [0004]. Thus, In my opinion, *You* and *Liu* both contemplate the same use case: monitoring M-PDCCH/DCI in an on duration of a paging (DRX)/DRX cycle. Accordingly, a POSA would have appreciated that *Liu*’s technique can be used to improve *You* in the same way taught by *Liu*. As another example, *You* pertains to monitoring M-PDCCH/DCI used in machine type communication (MTC). *You*, [173], [197]. Relatedly, *Liu* discloses that 5G/NR’s wide range of frequency spectrum (“up to 100GHz”), as well as the resulted flexible numerology, is aimed at addressing requirements such as “massive machine type communications.” *Liu*, [0002]; *supra*, Section VI.C. Accordingly, in my opinion, a POSA would have been motivated to apply *Liu*’s teachings to modify *You*’s M-PDCCH/DCI monitoring scheme, so that it can support communications among massive number of machines. *See e.g.*, *Xiong*, [0021] (“With respect to massive

MTC, the support of a massive number of Internet of Things (IoT) or MTC devices is expected to be a key feature for the 5G system.”)

112. Moreover, as part of the evolution of 3GPP systems, a POSA would have been motivated to improve *You*’s 4G/LTE system based on *Liu*’s 5G/NR oriented solutions. Both *You* and *Liu* pertain to 3GPP systems and refer to various 3GPP technical documents. *You* states that its solution is applicable to “the 3GPP LTE/LTE-A system.” *You*, [41]; *see also id.*, [40], [43], [93]. And *Liu* attempts to address the challenges posed by the 3GPP’s technical requirements for 5G/NR. *Liu*, [0002]-[0003]. As explained in Section VI.A, the development of 3GPP technical specifications is an ongoing, collaborative process in which newer, improved versions of the wireless technology are accumulatively built upon previous versions. For a POSA who tracks the 3GPP development process, it is a common and routine practice to exchange and look for new ideas through 3GPP-related meetings and publications. Thus, in my opinion, as part of the natural transition to 5G for *You*’s MTC, a POSA would have been prompted by *Liu*’s teachings to modify *You*’s technique to meet the requirements of the emerging 5G/NR system.
113. Moreover, a POSA would have appreciated that *Liu*’s M-PDCCH/DCI transmission/monitoring method is advantageous because it reduces the

UE's burden in monitoring the paging scheduling information in *You* (i.e., searching the transmission occasions of the M-PDCCH/DCI). As discussed in Section VI.B.6, "monitoring" means blind decoding the M-PDCCH/DCI search space for the paging scheduling information, without pre-knowledge about when (starting time point, duration) and where (subband location, bandwidth) the time-frequency resources for the paging M-PDCCH/DCI are located. *Liu* explains that the flexible numerology used by 5G/NR adds extra uncertainty to the blind decoding because a switch of the numerology (i.e., subcarrier spacing) will change the "DCI monitoring occasion[s]," i.e., the occasions when the transmissions occur and the blind decoding should be performed. *Liu*, Abstract, [0005], [0019], [0040], [0095], Fig. 2. For example, as shown in Figure 2 below, M-PDCCH/DCI may occur at slot level (e.g., per slot), so a scheduling unit is a slot and the M-PDCCH/DCI monitoring occasions (i.e., the time intervals in which the M-PDCCH/DCI is transmitted) are configured in the scheduling units (slots). *Liu* discloses that a subcarrier spacing change from 15 kHz to 60 kHz would cause the scheduling unit size (e.g., the slot size) to change. This further causes the M-PDCCH/DCI monitoring occasions to change. However, with the traditional blind decoding, the UE does not know when and how the subcarrier spacing and/or scheduling unit size would change. Thus, the UE would have to

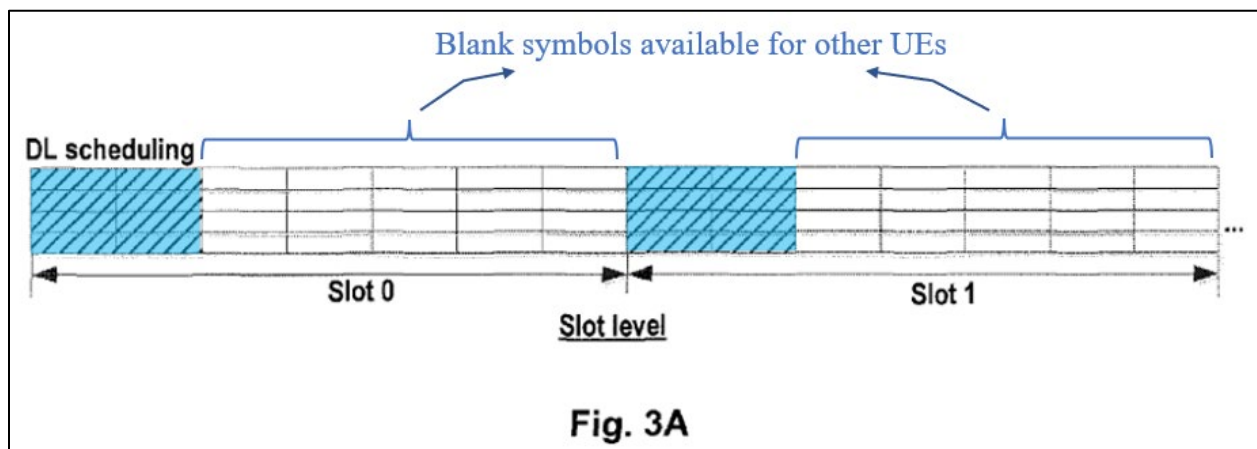
search the **M-PDCCH/DCI monitoring occasions** corresponding to *all* the supported **subcarrier spacings** (e.g., 15 kHz and 60 kHz), to look for the transmission of **M-PDCCH/DCI**. This would cause a significant drain to the UE's battery power. To solve this problem, *Liu* proposes transmitting to the UE a DCI configuration parameter, to indicate the change of the **subcarrier spacing**. *Liu*, Abstract, [0019], [0057], [0095]. This way, the UE can know the **scheduling unit** (e.g., **slot**) corresponding to the new **subcarrier spacing**, and only search the **PDCCH/DCI monitoring occasions** configured in the new **scheduling units** (e.g., **slots** corresponding to the new **subcarrier spacing**). *Id.* Therefore, a POSA would have appreciated that *Liu*'s solution can "mitigate or at least alleviate" the uncertainty in **PDCCH/DCI monitoring occasions** due to 5G/NR's flexible numerology. *Liu*, [0010] ("To this end, in the present disclosure, there is provided a new solution for DCI transmission and receiving in a wireless communication system, to mitigate or at least alleviate at least part of the issues in the prior art."). Moreover, with *Liu*'s solution, the UE flexibly knows which of the **slots** contain **PDCCH/DCI monitoring occasions**, and can avoid decoding attempts on **slots** that fail to contain a **PDCCH/DCI monitoring occasion**. Because of these benefits, a POSA would have been motivated to modify *You* according to *Liu*'s teachings.



Liu, Fig. 2.

114. Moreover, a POSA would have been motivated by *Liu*'s teachings to modify *You*'s M-PDCCH/DCI monitoring from subframe level to slot level, so as to more efficiently allocate the time-frequency resources in the control region. *Supra*, Sections VI.B.3 and VI.B.6. Specifically, *You* suggests that its subframe-level M-PDCCH/DCI monitoring may have to be configured on non-consecutive subframes because different subframes may be restricted to different UEs or control channels not related to paging M-PDCCH. *You*, [184]. Although *You* indicates that this does not necessarily increase transmission/reception latency, *You*, [184], a POSA would have understood that such rigidity could limit the number of UEs supportable by an MTC network. This problem can be alleviated by *Liu*'s slot-level M-PDCCH/DCI monitoring. Specifically, *Liu* solves this problem by expanding the

transmission/monitoring opportunities from “subframe level (multi-slot)” to “slot level” and “symbol level.” *Liu*, [0048]. “For example, with slot-level DCI monitoring configuration, [a] UE can [] be configured with a scheduling unit starting and ending from the symbol boundary rather than a slot boundary” or subframe boundary. *Liu*, [0062]. Thus, as shown in Figure 3A, “the remaining blank symbols can be allocated to other UE(s)” *Id.* Accordingly, applying *Liu*’s teachings to *You* would enable it to support massive MTC contemplated by 5G/NR. *Id.*, [0002].



Id., Fig. 3A.

115. In summary, in my opinion, a POSA would have been motivated to combine the teachings of *You* and *Liu* because they are directed to the same technical field (M-PDCCH/DCI transmission and reception), the same use case (monitoring the M-PDCCH/DCI in the on duration of a DRX/paging cycle), and the same problem (configuring and determining the DCI/P-PDCCH

monitoring occasions). A POSA would also have been motivated to modify *You*'s coverage enhancement scheme to harvest the many benefits of *Liu*'s technique and to address the challenges imposed by the emerging 5G/NR system.

b. The combination of would yield a predictable result

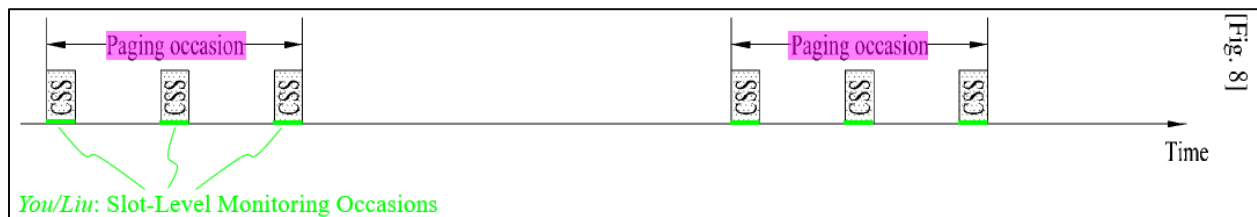
116. In my opinion, a POSA would have had a reasonable expectation of success in combining *You* and *Liu* and would have expected the combination to yield a predictable solution because they use highly analogous and compatible parameters. In particular, both *You* and *Liu* describe a UE that monitors one or more PDCCH/DCI occasions in the on duration of a paging (DRX)/DRX cycle, i.e., in a paging occasion. *You*, [174], [192]; *Liu*, [0004], [0048]-[0049]. *You* expressly addresses paging configuration parameters used for determining “CSS monitoring opportunities within a paging occasion,” while *Liu* expressly addresses DCI configuration parameters used for determining “DCI monitoring occasion[s].” *You*, [194], [196], [200]; *Liu*, Abstract, [0046]-[0049]. The following table shows the correspondence between *You*'s subframe-level M-PDCCH monitoring configuration and *Liu*'s slot-level DCI monitoring configuration. *Liu*, [0046]-[0049].

<i>You's</i> CSS_Paging Configuration	<i>Liu's</i> DCI Configuration
"duration of the paging occasion"	"valid duration for the DCI configuration parameter"
"period and offset of CSS stating subframe location"	"DCI occurrence occasions"
each of the "subframes configuring CSSs or search spaces on which the paging M-PDCCH is transmitted"	"duration for a single DCI"
"narrowband location for a paging occasion monitoring"	"frequency domain resource unit" and "frequency hopping pattern"

117. In my opinion, a simple substitution of *Liu's* DCI configuration parameter for *You's* CSS_paging configuration parameters would yield a slot-level M-PDCCH monitoring occasions within a paging occasion. Specifically, *You* discloses that "a paging occasion may be defined as an interval where a UE monitors a paging M-PDCCH" and "[a] duration of the paging occasion may be configured to be a multiple of the number of subframes configuring CSSs or search spaces on which the paging M-PDCCH is transmitted." *You*, [199]-[200]. *You* further discloses that the subframes on which the paging M-PDCCH is transmitted (herein referred to as "paging subframes") can be specified by a periodicity and offset. *Id.*, [196]. As shown in the figure below, a POSA would have readily recognized that the *You/Liu* combination's slot-level M-PDCCH/DCI monitoring occasions may be defined as follows:

- the duration of the **paging occasion** is set to be equal to *Liu*'s "valid duration for the DCI configuration parameter," which could be a single subframe containing multiple slots;
- the **paging occasion** includes one or more M-PDCCH **monitoring occasions** that have a periodicity and offset specified by *Liu*'s "DCI occurrence occasions," with the periodicity being zero if no coverage enhancement is used; and
- the duration of each M-PDCCH **monitoring occasion** is specified by *Liu*'s "duration for a single DCI," rather than being based on subframe durations.

Liu, [0046]-[0049], Fig. 2; *see also id.*, [0050]-[0051] (the DCI occurrence occasions can be "aperiodic," i.e., have zero periodicity).



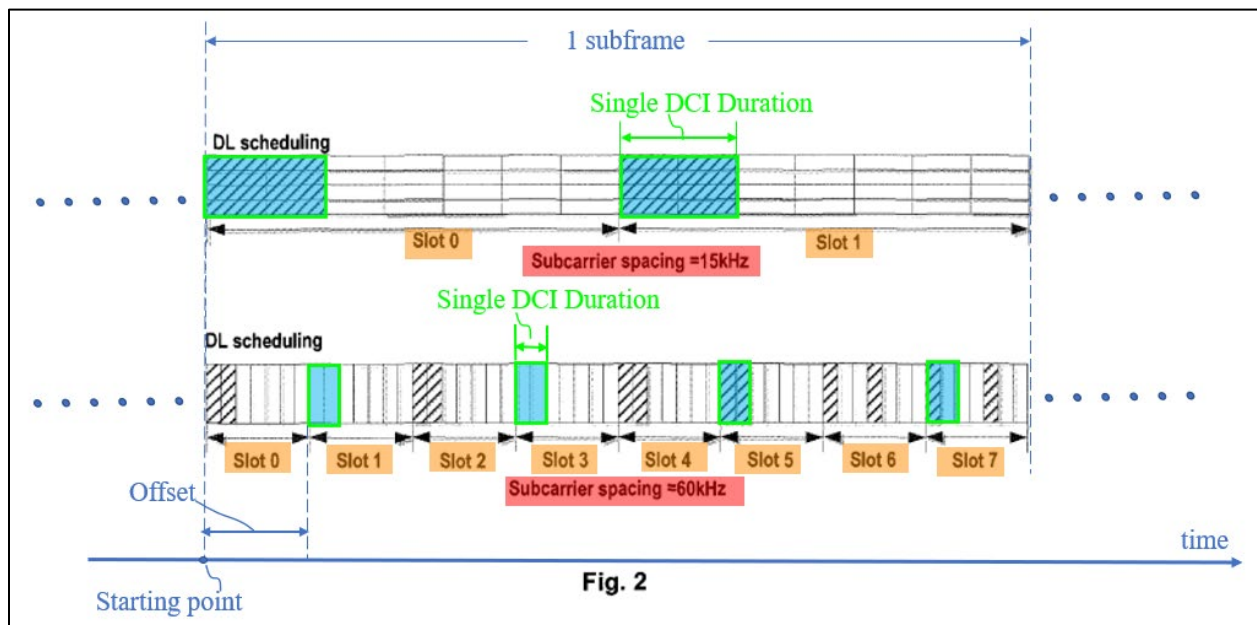
You, Fig. 8,

118. Also, in my opinion, a POSA would have known how to use *Liu*'s DCI configuration parameter to determine the resulting M-PDCCH/DCI monitoring occasions. Specifically, the DCI configuration information regarding the "numerology" (subcarrier spacing) and "DCI occurrence

occasions” (periodicity, offset from the starting point) can be used by the UE to determine the locations of the M-PDCCH/DCI monitoring occasions in the time domain. *Liu*, [0045], [0048]-[0049]. The “duration for a single DCI” can be used by the UE to determine the duration of each M-PDCCH/DCI monitoring occasion. *Id.*, [0047]. The “valid duration for the DCI configuration parameter” can be used by the UE to determine the total duration of the paging occasion. *Id.*, [0046]. And the “frequency domain resource unit” and “frequency hopping pattern” can be used by the UE to determine the subband location and bandwidth for monitoring the M-PDCCH/DCI. *Id.*, [0054]-[0055].

119. For example, the following Figure 2 of *Liu* shows that a subframe is divided into different number of slots according to the “numerology” (subcarrier spacing). *Id.*, [0045], Fig. 2. The periodicity and offset of the M-PDCCH/DCI specify the locations of the M-PDCCH/DCI monitoring occasions with respect to the slots. For example, as annotated below: when the subcarrier spacing is 15 kHz, periodicity is per slot, and offset is zero, then the M-PDCCH/DCI monitoring occasions are in every slot starting from slot 0; whereas when the subcarrier spacing is 60 kHz, periodicity is per double-slot, and the offset is one slot, the M-PDCCH/DCI monitoring occasions are at every other slot starting from slot 1. Moreover, Figure 2

shows that the duration of each **M-PDCCH/DCI monitoring occasion** is indicated by the “duration for a single DCI.” *Id.*, [0047]. Figure 2 does not show the “valid duration for the DCI configuration,” but a POSA understood that the **M-PDCCH/DCI monitoring occasions** repeat in the “valid duration for the DCI configuration” (i.e., paging occasion) according to the period specified by the “DCI occurrence occasions.” *Id.*, [0046]. Evidently, despite the complexity caused by the flexible numerology in 5G/NR, using *Liu*’s DCI configuration parameter in *You* enables the UE to accurately determine the **M-PDCCH/DCI monitoring occasions**.



Liu, Fig. 2.

120. Moreover, in my opinion, a POSA would also have a reasonable expectation of success for the resulting combination because the purpose of *Liu*’s

solution is to mitigate or alleviate the uncertainty “due to [the change of] numerology and scheduling unit size,” and to make the M-PDCCH/DCI monitoring occasions predictable by a UE. *Liu*, Abstract, [0019]. Thus, the UE would have a higher success rate in finding the right M-PDCCH/DCI monitoring occasions because it is only decoding the Y time intervals that are scheduled to contain an X time interval. Moreover, the modification requires less time and battery power to locate the time-frequency resources for receiving the M-PDCCH/DCI, the UE operation is less likely to experience interruption or crash.

121. A POSA would also have a reasonable expectation of success for the resulted combination because it merely requires combining prior elements according to known methods. Particularly, *You* discloses that the paging M-PDCCH search space is specified by a set of CSS_paging parameters. *You*, [250] (Table 13). *You* discloses that a base station can transmit the CSS_paging parameters to a UE via a system information block (SIB) or radio resource control (RRC) message, so that the UE may monitor the paging M-PDCCH according to the parameters. *Id.*, [235], [293]. Similarly, *Liu* discloses that the DCI configuration parameter can be transmitted to the UE by a high layer signaling like RRC signaling, or another DCI. *Liu*, [0058]-[0059]. Thus, a POSA would have found it obvious to incorporate

Liu's DCI configuration parameter in *You*'s CSS_paging parameters and transmit them to the UE via an SIB, RRC, or DCI message. These messages are old, routine communication methods used in the art to communicate control data.

122. Additionally, although *You*'s UE monitors the paging M-PDCCH/DCI at the subframe level while *Liu* "DCI occurrence occasions" can be at slot level, multi-slot level, or even symbol level, such difference does not require any modification to the UE's fundamental design. Rather, *Liu* teaches that there is no fundamental difference between *You*'s subframe-level monitoring and *Liu*'s monitoring at the slot level, multi-slot level, or symbol level. *Liu*, [0049] (describing the "periodicity" can be flexibly configured at "symbols, slots, or frames"). For example, since a slot is comprised of a plurality of symbols, a POSA would have understood that the rate of monitoring in *You* could be easily accelerated from the subframe level to the slot level or even the symbol level, since the device is already operating at the symbol level to perform other physical layer tasks. Thus, changing from the subframe-level monitoring to the slot-level monitoring at best requires the UE to operate at a faster sampling rate for monitoring the paging scheduling information, which happened before the time of the '767 patent. Also, *Liu*'s solution increases battery life because the UE is only decoding a subset of the Y time

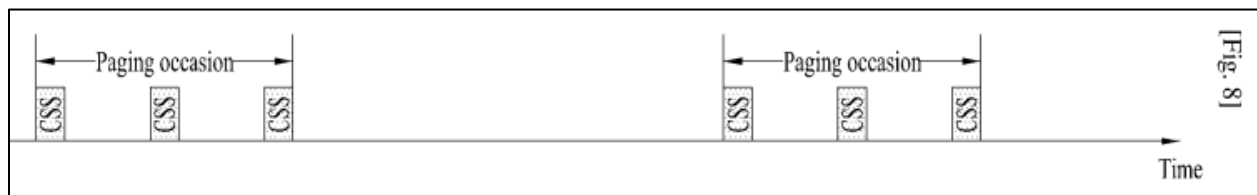
intervals according to a monitoring schedule that specifies which of the *Y* time intervals contains an *X* time interval. The UE electronics have to operate at the same speed in both *You* and *Liu* since both require decoding the OFDM symbols that contain a DCI. Moreover, a POSA would have appreciated that changing to the slot or symbol levels is advantageous because it reduces the system latency, which is one of the goals of 5G/NR.

123. In summary, in my opinion, a POSA would have recognized that modifying *You* according to *Liu*'s teachings would yield a predictable result. Moreover, in my opinion, a POSA would have had a reasonable expectation of success for such modification because it only requires simple combination of substitution of known elements in the prior art.

4. Independent Claim 1

a. [1pre]: "A method in a User Equipment (UE) for paging, comprising:"

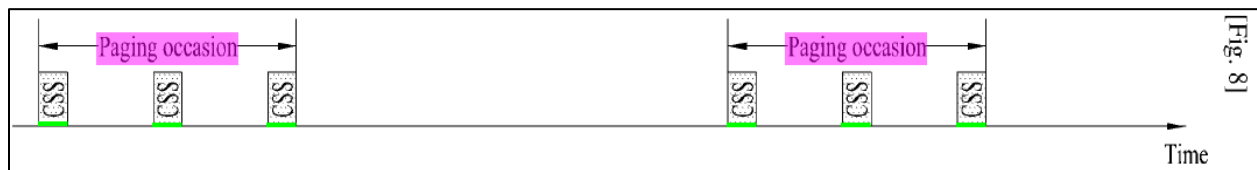
124. As shown in Figure 8, *You* discloses a method for a UE to monitor a paging M-PDCCH at a paging occasion, by searching through an M-PDCCH common search space (CSS) that is configured over one or more downlink subframes in the paging occasion. *You*, [185]-[187], [199].



You, Fig. 8.

b. [1a]: “monitoring a first signaling in X time intervals; and”

125. *You* alone or further in view of *Liu* teaches this limitation. As discussed in Section IX.A.4.a and paragraph 122, *You* discloses that the UE monitors a paging M-PDCCH in one or more downlink subframes of a paging occasion. *You*, [185]-[187], [199]. Specifically, when coverage enhancement is applied, in the paging occasion, multiple repetitions of an M-PDCCH search space in which the paging M-PDCCH could be found are configured over multiple subframes respectively, wherein the multiple subframes may be consecutive or non-consecutive. *Id.*, [183]-[185], [187]. However, when there is no coverage enhancement, the M-PDCCH search space is not repeated, i.e., it only exists in one subframe. *Id.*, [186].



Id., Fig. 8.

126. *You*’s paging M-PDCCH discloses the claimed “first signaling” because *You* discloses that “a physical downlink control channel (PDCCH) . . . refer[s] to a set of time-frequency resources or resource elements (REs) carrying downlink control information (DCI)” *Id.*, [47]; ’767 patent, 20:10 (“the

first signaling is DCI”), 20:13-14 (“the first signaling is transmitted through a PDCCH”); Moreover, *You*’s **one or more downlink subframes** in a paging occasion disclose the claimed “**X time intervals**” because each subframe is a time interval. *Supra*, Section VI.B.3.

127. Moreover, as discussed in Section IX.A.3, *Liu* discloses a method for a UE to monitor **DCI** in **one or more DCI monitoring occasions at slot level**, and it would have been obvious to adapt *You*’s subframe-level monitoring for *Liu*’s slot-level monitoring. *Liu*, [0044], [0046], [0048]. Therefore, *You* in view of *Liu* also teaches limitation [1a].

c. [1b]: “receiving a first radio signal;”

128. *You* discloses this limitation by disclosing that “[i]f the **paging M-PDCCH** . . . is received within the corresponding interval [of a current paging occasion], the UE may receive a **PDSCH carrying the corresponding paging message.**” *You*, [199]. Here, the **PDSCH** discloses the claimed “**first radio signal**” because *You* discloses that “a physical downlink shared channel (PDSCH) refer[s] to . . . a set of time-frequency resources or REs carrying downlink data” *You*, [47]. A POSA would have understood that the set of time-frequency resources occupied by the **PDSCH** is a **radio signal**. ’767 patent, 19:54-62 (“the rectangle filled by crossed oblique lines represents a time-

frequency resource occupied by the first radio signal”), 20:18-19 (“the first radio signal is transmitted through a PDSCH”).

d. [1c]: “wherein **X is a positive integer;”**

129. As discussed for limitation [1a], *You* alone or further in view of *Liu* teaches that the **paging M-PDCCH** is monitored in **one or more (i.e., a positive integer) time intervals**.

e. [1d]: “the **first signaling is used for determining scheduling information for the **first radio signal**;”**

130. *You* alone or further in view of *Liu* teaches this limitation. In particular, *You* discloses that “the **PDSCH carrying the paging message** may be scheduled by PDCCH/**M-PDCCH**.” *You*, [193]; *see also id.*, [188] (“M-PDCCH CSS for paging message scheduling”), [194] (“the UE may attempt reception of M-PDCCH for scheduling the paging message”), [196] (“M-PDCCH monitoring for paging message scheduling”), [199] (“a paging message scheduled by the corresponding M-PDCCH”), [293] “transmit M-PDCCH for scheduling a paging message within CSS_paging”);

131. Further, *You* discloses that the DCI transmitted on the **paging M-PDCCH** contains scheduling information for the **PDSCH carrying the paging message**. *You* discloses that 3GPP defines various DCI formats to specify the size and usage of the DCI. *You*, [104]. Among them, “DCI format 1C” corresponds to “[v]ery compact resource assignments for PDSCH (e.g.

paging/broadcast system information).” *Id.*, Table 7. Here, the DCI regarding the resource assignments is used for schedule the PDSCH carrying the paging message.

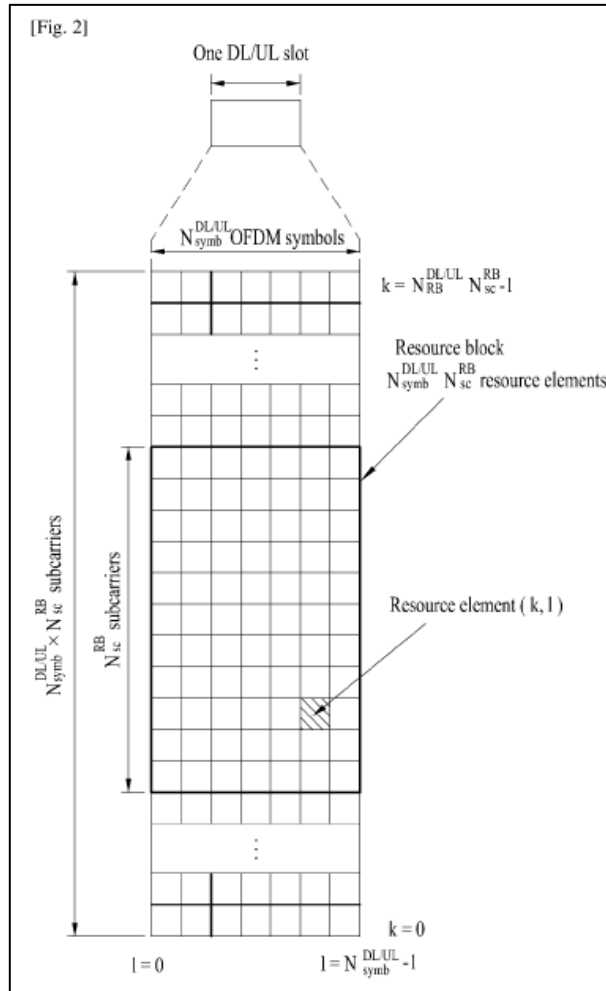
132. Moreover, *Liu* discloses that the DCI can include “scheduling information.” *Liu*, [0085]. And, as discussed in Section IX.A.3, it would have been obvious to modify *You*’s paging M-PDCCH monitoring method according to *Liu*’s DCI monitoring method. Therefore, *You* in view of *Liu* also teaches limitation [1d].

f. [1e]: “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};”

133. *You* alone or further in view of *Liu* teaches this limitation. In my opinion, the phrase “at least one of {}” in limitation [1e] is disjunctive because there is no basis in the specification or prosecution history for reading it to require all the elements recited in the curly brackets “{}.” For example, the specification of the ’767 patent suggests that the usage of “{}” is disjunctive: “ $N = \min(Z, nB)$, nB is equal to one of $\{4Z, 2Z, Z, Z/2, Z/4, Z/8, Z/16, Z/32, Z/64, Z/128, Z/256, Z/512, Z/1024\}$.” ’767 patent, 5:20-23. Here, at any given time, nB is equal to only one of the values listed in “{}.” Moreover, the ’767 prosecution history does not contain any explanation on the usage

of “{ }.” *See* Ex. 1004. I was informed by counsel that a prior art reference discloses limitation [1e] if it discloses one of the alternatives recited in “{ }.”

134. *You* discloses that the DCI transmitted on the [paging M-PDCCH](#) includes information such as “RB allocation,” “modulation coding scheme (MCS),” etc. *You*, [104]. “RB” is the abbreviation for “resource block,” which is defined to contain a predetermined number of consecutive symbols in the time domain and a predetermined number of consecutive subcarriers in the frequency domain. [59], [61], Fig. 2. Accordingly, in my opinion, *You* discloses limitation [1e] by disclosing the scheduling information includes both occupied time-frequency resource and adopted Modulation Coding Scheme (MCS), either of which is sufficient to meet the limitation.



You, Fig. 2.

135. Moreover, *Liu* discloses that the DCI includes information of “MCS” and “resource allocation.” *Liu*, [0083], [0085]. And, as discussed in Section IX.A.3, it would have been obvious to apply *Liu*’s teachings to *You*’s paging M-PDCCH monitoring method. Therefore, *You* in view of *Liu* also teaches limitation [1e].

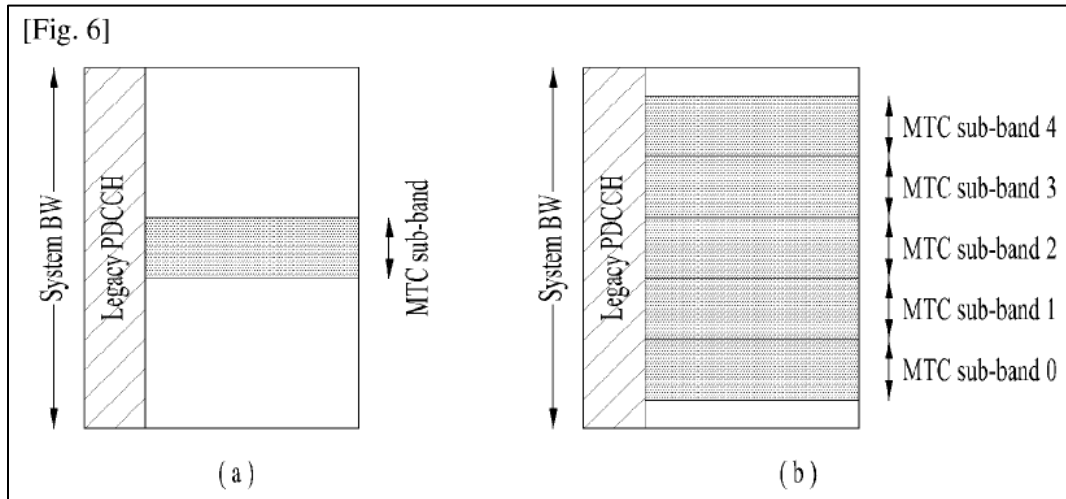
g. [1f]: “the first radio signal carries a paging message;”

136. As discussed for limitation [1b], *You* discloses that the “PDSCH” received by the UE “carr[ies] the corresponding paging message.” *You*, [199]; *see also id.*, [193] (“[t]he paging message may be transmitted through a PDSCH”);

h. [1g]: “the frequency domain resource used for transmitting the first signaling belongs to a first subband;”

137. *You* discloses this limitation. *You* discloses that the paging M-PDCCH is monitored by a machine type communication (MTC) UE that operates “at a reduced UE downlink and uplink bandwidth.” *You*, [176]. Figure 6 of *You* shows exemplary subbands (i.e., narrowbands) for the MTC. *Id.*, [175], Fig. 6. *You* discloses that an M-PDCCH is “a control channel transmitted within a subband where MTC is operated for the MTC UE.” *Id.*, [177]. *You* further discloses that the M-PDCCH is monitored at a specific narrowband location. *Id.*, [194] (“Then, a narrowband location for a paging occasion monitoring of a UE is determined by at least UE ID at least for paging record(s).”), [235] (“The UE may monitor M-PDCCH candidates of CSS within subframe(s) and/or narrowband(s) according to the CSS_paging configuration.”). In view of these teachings, a POSA would have understood

that the frequency domain resource used for transmitting the **paging M-PDCCH** belongs to an MTC subband (claimed “first subband”).

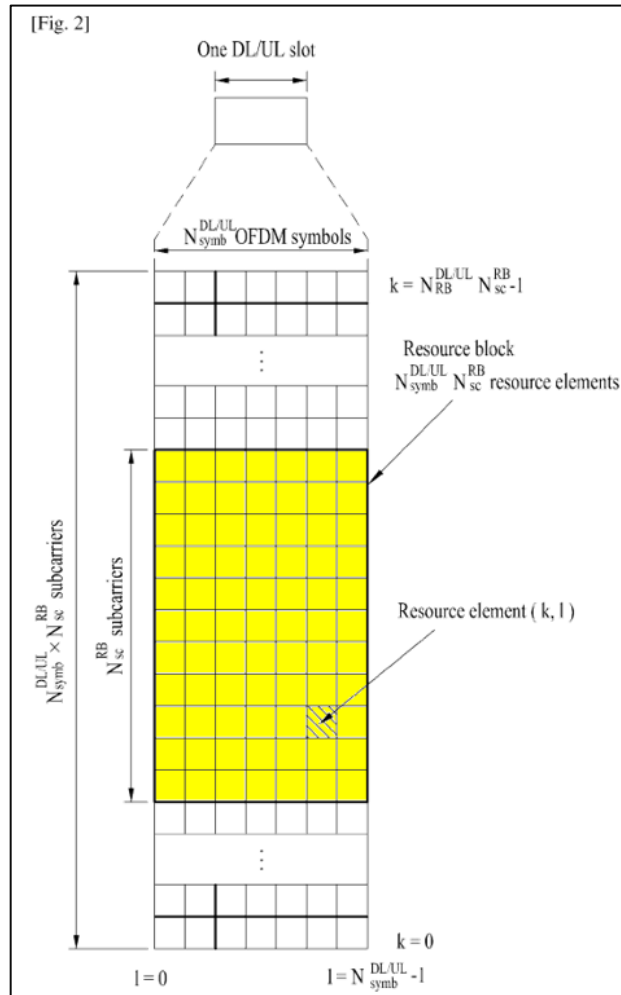


You, Fig. 6.

- i. [1h]: “the first subband comprises a positive integer number of consecutive subcarriers in frequency domain; and”

138. *You* discloses this limitation. Specifically, *You* discloses that the subband for monitoring the paging M-PDCCH is configured on several physical resource blocks (PRBs). *You*, [176], Fig. 6 (above). Referring to Figure 2, below, *You* further discloses that “[a] PRB is defined as . . . $N^{\text{RB}}_{\text{sc}}$ (e.g. 12) **consecutive subcarriers** in the frequency domain.” *Id.*, [62] (emphasis added). As shown in Figure 2, *You* explains that a PRB can be mapped to a resource block (highlighted below), which includes $N^{\text{RB}}_{\text{sc}}$ consecutive subcarriers. *Id.*, [61]-[62]. Therefore, the subband for monitoring the paging M-PDCCH

comprises a positive integer number of consecutive subcarriers in frequency domain.



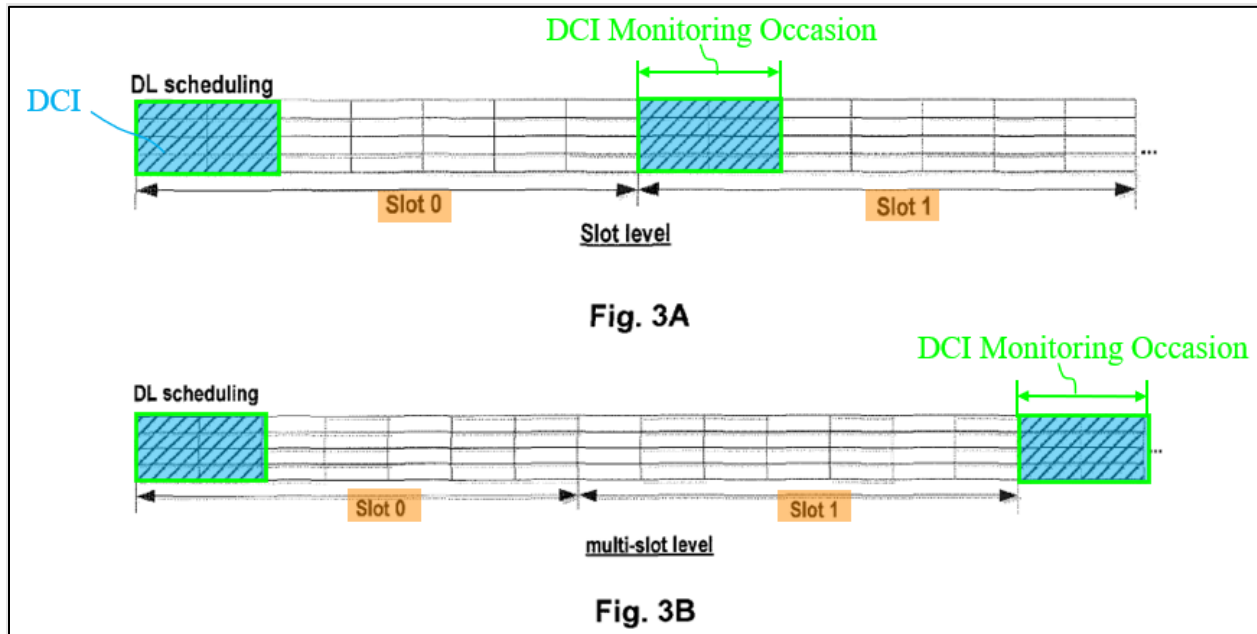
You, Fig. 2.

- j. [1i]: “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.”

139. In my opinion, *You* in view of *Liu* teaches this limitation. As discussed below, *Liu* discloses using subcarrier spacing⁶ to determine X time intervals for monitoring DCI. And it would have been obvious to apply this teaching to *You*’s M-PDCCH monitoring method.
140. Specifically, *Liu* discloses that a UE monitors DCI at one or more DCI monitoring occasions, namely, the “DCI occurrence occasions” specified by the DCI configuration parameter. *Liu*, [0044], [0048]. The DCI occurrence occasions (DCI monitoring occasions) can be periodically arranged at, for example, slot level. *Id.*, [0048]-[0049]. For example, Figure 3A shows that the DCI monitoring occasions are at every slot, while Figure 3B shows that the DCI monitoring occasions are at every two slots (i.e., every other slot). *Id.*, [0049]. Here, *Liu*’s DCI monitoring occasions disclose the claimed “X time intervals” for monitoring the DCI (claimed “first signaling”).

⁶ Similar to the discussion in Section VI.A.4.f for limitation [1e], the phrase “at least one of {}” is disjunctive. Accordingly, the cited prior art references can disclose limitation [1i] if they teach one of the alternative elements recited in “{}.”



Liu, Figs. 3A and 3B.

141. *Liu* discloses that the UE “may learn the time-frequency resource for the DCI from the DCI configuration parameter,” which includes the **subcarrier spacing** information, “and monitor the DCI within the time-frequency resource.” *Liu*, [0057]; *see also id.*, [0095]. As discussed below, *Liu* discloses using the **subcarrier spacing** to determine three different aspects of the time-frequency resource associated with the “**X time intervals**”:

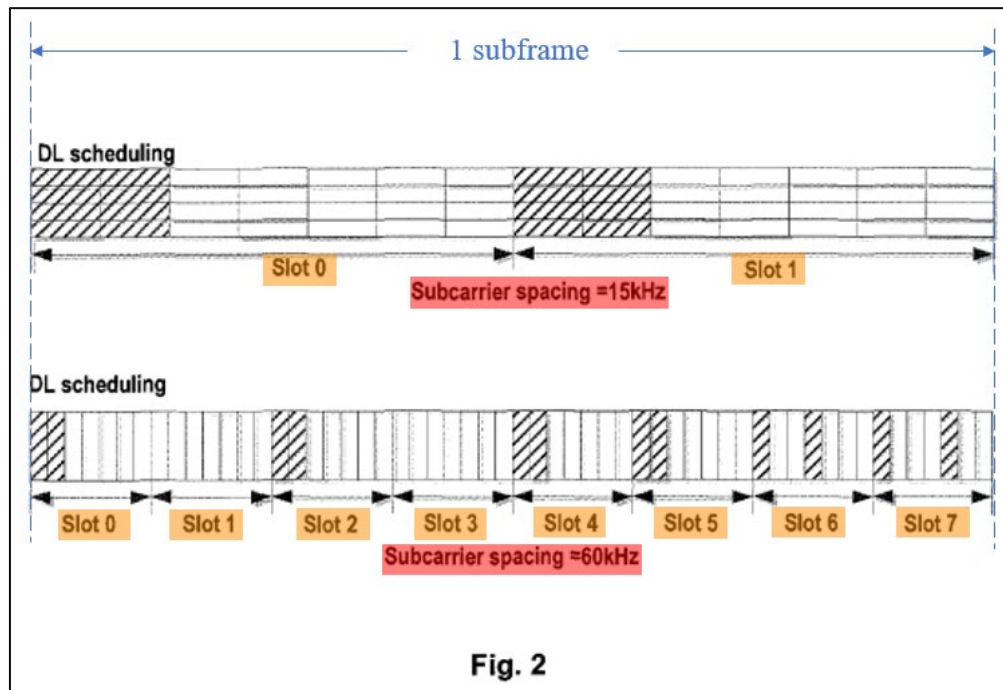
- time-domain locations (**slot** locations) of the claimed “**X time intervals**;”
- duration of each one of the claimed “**X time intervals**”—the duration of each **DCI monitoring occasion**; and

- the number of the claimed “X”—the number of DCI monitoring occasions in an on duration of a DRX cycle, e.g., a paging occasion.

i. Time-domain locations of the “X time intervals”

142. As discussed in Section VII.A, the ’767 patent describes a method that first determines Y time intervals based on the subcarrier spacing, and then determines which one(s) of the Y time intervals include(s) the X time intervals. ’767 patent, 18:55-64, Fig. 7. The same method is disclosed by *Liu*.
143. *Liu* discloses that the UE uses the DCI configuration parameter to determine the time-frequency resources for monitoring the DCI. *Liu*, [0057], [0095]. To that end, *Liu* discloses that the “numerology to be used” (subcarrier spacing) is used for determining the slots in a subframe, and the “DCI occurrence occasions” (periodicity, offset) are used to determine the time-domain locations of the DCI monitoring occasions with respect to the slots. *Id.*, [0044]-[0045], [0049]. The above process is illustrated by *Liu*’s Figure 2. Different subcarrier spacings correspond to different symbol durations and thus cause a subframe to be divided into different numbers of slots: under the 15 kHz subcarrier spacing, the UE divides a subframe into two longer slots; whereas under the 60 kHz subcarrier spacing, the UE divides a subframe into eight shorter slots. *Id.*, [0045]. Due to the differing slot

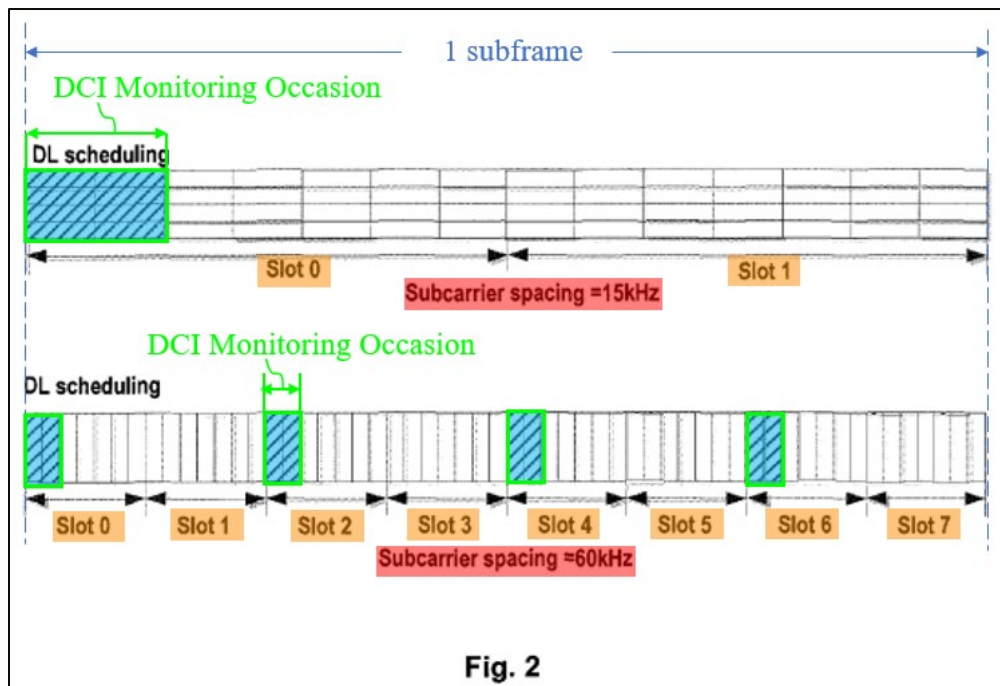
numbers and durations, corresponding **slots** (e.g., slot 0 or slot 1 in Figure 2) under different **subcarrier spacings** occupy different locations in the time domain of a subframe and a frame. It follows that the **DCI monitoring occasions** in the **slots** have different time-domain locations of a subframe and a frame.



Liu, Fig. 2.

144. To further illustrate the concept, I modified *Liu*'s Figure 2 in the drawings below to show double-slot periodicity and zero offset: under the **15 kHz subcarrier spacing**, a **DCI monitoring occasion** is in **slot 0**; whereas under the **60 kHz subcarrier spacing**, **DCI monitoring occasions** are in **slots 0, 2, 4, 6**.
- Liu*, Fig. 2. As shown, in my opinion, a POSA would have understood that the time-domain locations (i.e., **slot** locations) of the **DCI monitoring**

occasions depend on the subcarrier spacing, and the UE uses the subcarrier spacing to determine which slots contain the DCI monitoring occasions (claimed “X time intervals”). Thus, in my opinion, a POSA would have understood that the UE would use the subcarrier spacing to determine the time-domain locations (slot locations) of the DCI monitoring occasions (claimed “X time intervals”).

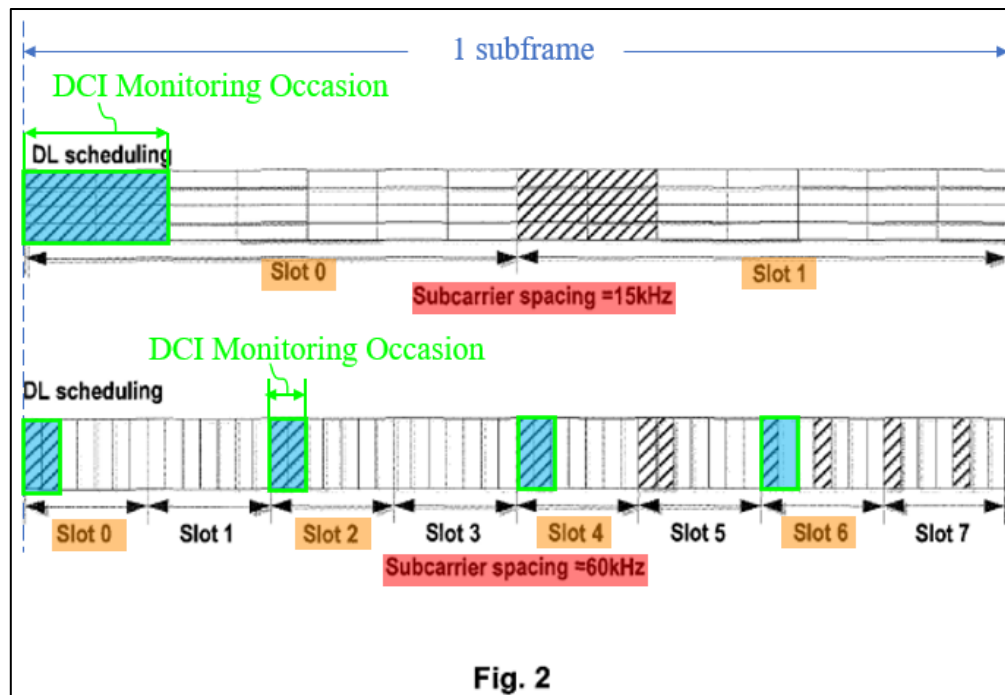


Liu, Fig. 2 (modified).

ii. Duration of each one of the “X time intervals”

145. *Liu* also discloses that the UE uses the subcarrier spacing to determine the duration of each DCI monitoring occasion. *Liu* discloses that the “duration for a single DCI” indicates the time length of a single DCI monitoring occasion, which “can be a number of symbols.” *Liu*, [0047]. *Liu* further

discloses that “different **subcarrier spacings** mean different symbol lengths,” e.g., the symbol length for 15 kHz has “a time length four times as that for 60 kHz.” *Id.*, [0045]; *id.* (“the numerology to be used can be used to define a symbol”). It follows that the **subcarrier spacing** is used to determine the duration of each of the **DCI monitoring occasions** (claimed “**X time intervals**”).

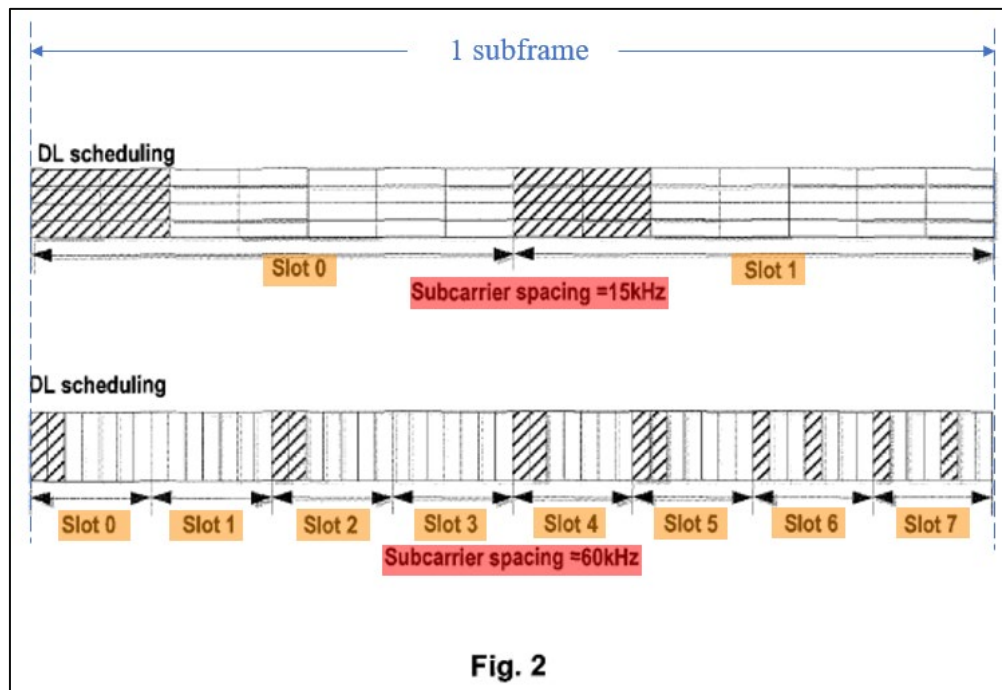


Liu, Fig. 2

iii. Number of “X”

146. *Liu* also discloses that the UE uses the **subcarrier spacing** to determine the number of **DCI monitoring occasions** in a DCI search space. Particularly, *Liu* discloses that “the DCI monitoring will be performed periodically, for example, every a predetermined number of slots” *Liu*, [0049]. As

shown in the following annotated Figure 2 of *Liu*, the number of slots under the 60 kHz subcarrier spacing is four times the number of slots under the 15 kHz subcarrier spacing. *Liu*, [0045]. Thus, for a given periodicity of the DCI monitoring occasions over the slots, the number of DCI monitoring occasions depends on the subcarrier spacing. Therefore, in my opinion, a POSA would have understood that the subcarrier spacing must be used to determine the number of DCI monitoring occasions.



Liu, Fig. 2.

iv. Resulting combination of *You* and *Liu*

147. For the reasons in Section IX.A.3, a POSA would have found it obvious to substitute *Liu*'s "valid duration for the DCI configuration parameter" for the duration of *You*'s paging occasion, substitute *Liu*'s "DCI occurrence

occasions” for the period and offset of *You*’s M-PDCCH monitoring occasions, and substitute *Liu*’s “duration for a single DCI” for the duration of each of *You*’s M-PDCCH monitoring occasions. The resulting combination would use *Liu*’s “numerology” and “DCI occurrence occasions” to determine the time-domain locations and number of the M-PDCCH monitoring occasions, and use the “numerology” and “duration for a single DCI” to determine the duration of each M-PDCCH occasion. *Liu*, [0045], [0047]-[0049], Fig. 2. A POSA would have appreciated that the resulting slot-level M-PDCCH monitoring, compared to the subframe-level monitoring, would be advantageous because it would reduce the system latency. This is particularly useful in *You*’s coverage enhancement mode, which requires multiple repetitions of the M-PDCCH/DCI transmission. In my opinion, a POSA would have expected the resulting combination to work well in a 5G/NR system because, by using *Liu*’s method, the UE can precisely determine the time-domain locations, durations, and number of the M-PDCCH/DCI monitoring occasions at the slot level, despite the duration of a slot and the number of slots in a subframe change with the subcarrier spacing.

5. Claim 4

- a. [4a]: “The method according to claim 1, further comprising: receiving a second radio signal;”**

148. *You* in view of *Liu* teaches claim 1 and this limitation. First, *You* discloses that a method for a UE to receive an SIB message that includes information for reconfiguring the time-frequency resources for monitoring the paging M-PDCCH. Specifically, *You* discloses that the “CSS_paging are configured by SIB” (i.e., system information block), which is transmitted through “broadcast” or “dedicated” channels. *You*, [235], [70]. Namely, “[t]he eNB processor . . . may configure or reconfigure CSS_paging” and “[t]he UE processor . . . may control the UE RF unit to receive configuration or reconfiguration information on CSS_paging from the eNB.” *Id.*, [293]. The CSS_paging configuration/reconfiguration information includes parameters that are “configured by SIB” and describe the time domain resources (e.g., repetition number “ $R_{\max}$ ”) and the frequency domain resources (e.g., “PRB-sets” and “[n]arrowband[s]”) used for transmitting the CSS_paging. *Id.*, [250] (Table 13). Thus, *You* alone discloses the claimed “second radio signal” by disclosing the SIB message.

149. Second, *Liu* discloses that the UE can receive information for reconfiguring the time-frequency resources for monitoring DCI. Specifically, *You* discloses that the UE receives “a DCI configuration parameter” that

“indicates the time-frequency resources for the following DCI.” *Liu*, [0088].

The DCI configuration parameter may include, among others, “numerology to be used” and “a frequency domain resource unit.” *Liu*, [0089]-[0090].

Because *Liu* discloses that the numerology can change, a POSA understood that the DCI configuration parameter is transmitted in real time to reconfigure the DCI monitoring occasions upon a change of the numerology. *Id.*, [0003], [0005], [0019], [0040].

150. Third, it would have been obvious to modify *You*’s SIB message for reconfiguring CSS_paging, to include *Liu*’s DCI configuration parameter. Specifically, for the reasons discussed in Section IX.A.3, a POSA would have been motivated to combine the teachings of *You* and *Liu*. Additionally, a POSA would have appreciated that *You*’s method can be improved by *Liu*’s DCI configuration parameter, because it enables the UE to operate in a 5G/NR system and determine DCI monitoring occasion change caused by numerology change. *Liu*, Abstract, [0019], [0040], [0095]; Moreover, because both *You*’s SIB message and *Liu*’s DCI configuration parameter serve the same purpose of reconfiguring the time-frequency resources used for monitoring M-PDCCH/DCI, it would have been a natural choice to transmit *Liu*’s DCI configuration parameter via *You*’s SIB message. Moreover, a POSA would have had a reasonable expectation for the

modification because it requires no more than combining prior art elements (*You*'s SIB message for reconfiguring CSS_paging and *Liu*'s DCI configuration parameter for reconfiguring DCI monitoring occasions) according to known methods (transmitting the SIB message and DCI configuration parameter to the UE before the actual M-PDCCH/DCI occurrence) to yield predictable results (expanding the CSS_paging configuration parameters shown in *You*'s Table 13 to include *Liu*'s DCI configuration parameter) and therefore make it compatible with 5G/NR.

151. In summary, *You* in view of *Liu* teaches a method for the UE to receive a SIB message for reconfiguring the time-frequency resources for monitoring the M-PDCCH/DCI. The '767 patent states that the "second radio signal" may carry "System Information Block (SIB) information." '767 patent, 5:43-44. Just like the '767 patent, *You/Liu*'s SIB message constitutes the claimed "second radio signal." *You*, [70].

b. [4b]: "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}."

152. As discussed for limitation [4a], it would have been obvious to modify *You*'s SIB message (claimed "second radio signal") to include *Liu*'s DCI configuration parameter. *Liu* further discloses that the DCI configuration parameter includes "a numerology to be used" and a "frequency domain

resource unit.” *Liu*, [0044], [0053]. *Liu* discloses that the numerology corresponds to a “subcarrier spacing[]” (claimed “subcarrier spacing”) and the frequency domain resource unit specifies “a subband” (claimed “location of the first subband”). *Id.*, [0045], [0054]. Therefore, the combination renders this limitation obvious.

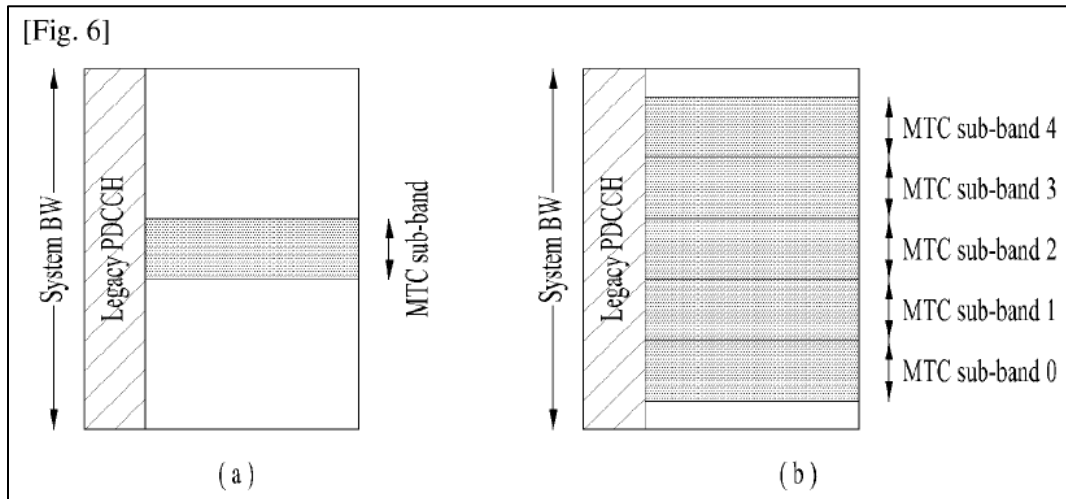
6. Claim 5

a. [5a]: “The method according to claim 1, further comprising: receiving a second signaling;”

153. *You* in view of *Liu* teaches claim 1, and *You* discloses this limitation. The ’767 patent’s specification states that the “second signaling” may be an “[R]RCC[] signaling” or “an SIB.” ’767 patent, 6:33-35. Likewise, *You* discloses that “[t]he eNB processor may control the eNB RF unit to transmit [an] SIB or RRC message, which includes configuration for CSS_paging, to the UE” *You*, [293]; *see also id.*, [235] (“The UE may identify the configuration of CSS_paging by reading SIB.”). *You* also discloses that “[t]he UE may attempt reception of paging M-PDCCH from CSS_paging according to the CSS_paging configuration.” *Id.*, [293]. Thus, *You* discloses that the UE receives an SIB/RRC message that includes CSS_paging configuration (claimed “second signaling”).

b. [5b]: “wherein the second signaling is used for determining Q subbands, Q being a positive integer;”

154. *You* discloses this limitation by disclosing that the CSS_paging configuration includes, for example, five “paging narrowbands configured by SIB.” *You*, [250] (Table 13), Fig. 6.



You, Fig. 6.

c. [5c]: “the first subband belongs to one of the Q subbands;”

155. *You* discloses this limitation. As discussed for limitation [1g], *You* discloses the claimed “first subband” by disclosing that the UE performs paging M-PDCCH monitoring in a narrowband. *You*, [194]. *You* further discloses that this narrowband is “[d]etermined by [a] UE ID among paging narrowbands configured by SIB.” *Id.*, [250] (Table 13).

d. [5d]: “any one of the Q subbands comprises a positive integer number of consecutive subcarriers; and”

156. *You* discloses this limitation. *You* discloses that a narrowband is configured on several physical resource blocks (PRBs). *You*, [176]. *You* further discloses that a PRB includes “consecutive subcarriers in the frequency domain.” *Id.*, [62]. Therefore, a POSA would have understood that any one of the paging narrowbands configured by SIB (claimed “Q subbands”) comprises consecutive subcarriers.

e. [5e]: “the feature ID of the monitor of the first signaling is used for determining the first subband in the Q subbands.”

157. *You* discloses this limitation. As discussed for limitation [1a], *You* discloses a UE for “monitoring a first signaling.” *You*, [185]-[187], [199]. And as discussed for limitation [5c], *You* discloses that the UE ID (claimed “feature ID of the monitor”) is used for determining a narrowband (claimed “first subband”) among paging narrowbands configured by SIB (claimed “Q subbands”). *Id.*, [250] (Table 13); *see also id.*, [176] (“[T]he UEs may use their respective subbands different from each other. . .”). *You* further discloses that the UE ID can be a cell-RNTI (C-RNTI). *You*, [85], [107]; ’767 patent, 19:47 (“[T]he feature ID refers to a C-RNTI.”). Thus, in my opinion, *You* discloses using a feature ID (e.g., C-RNTI) of the monitor of the first signaling for determining the first subband (e.g., a paging

narrowband) in the Q subbands (e.g., multiple paging narrowbands configured by SIB).

7. Claim 6

a. [6pre]: “A method in a base station for paging, comprising:”

158. As discussed for claim [1pre], *You* discloses a method for a UE to monitor a paging M-PDCCH over one or more downlink subframes in a paging occasion. *You*, [185]-[187], [199]. Although this wireless communication method is primarily described from the perspective of the UE, *You* also discloses the corresponding method performed by the base station because the method involves the UE wirelessly interfacing with the base station. For example, a radio signal that is transmitted from the UE is also received by the base station for wireless communication. Likewise, a radio signal that is received by the UE is also transmitted by the base station for wireless communication.

b. [6a]: “transmitting a first signaling in a positive integer number of time intervals of X time intervals; and”

159. As discussed for claim [1a], *You* alone or further in view of *Liu* teaches a UE monitoring a paging M-PDCCH/DCI (claimed “first signaling”) in one or more X time intervals. *You*, [183]-[187], [199]; *Liu*, Abstract, [0019], [0044], [0046]-[0048]. Thus, *You* alone or further in view of *Liu* also teaches

the base station “transmitting a **first signaling** in a positive integer number of time intervals of **X time intervals**.”

c. [6b]: “transmitting a **first radio signal;**”

160. As discussed for claim [1b], *You*’s UE receives a **PDSCH carrying a paging message** (claimed “**first radio signal**”). *You*, [199]. Thus, *You* also discloses the base station “transmitting a first radio signal.”

d. [6c]: “wherein **X is a positive integer;**”

161. As shown by the claim comparison in Section VII.B, limitation [6c] is substantially similar to limitation [1c]. Thus, for the reasons discussed for limitation [1c], it is my opinion that *You* alone or further in view of *Liu* teaches this limitation.

e. [6d]: “the **first signaling is used for determining scheduling information for the first radio signal;**”

162. As shown by the claim comparison in Section VII.B, limitation [6d] is substantially similar to limitation [1d]. Thus, for the reasons discussed for limitation [1d], it is my opinion that *You* alone or further in view of *Liu* teaches this limitation.

f. [6e]: “the scheduling information comprises at least one of {occupied time-frequency resource, adopted MCS, subcarrier spacing of subcarriers in occupied frequency domain resource};”

163. As shown by the claim comparison in Section VII.B, limitation [6e] is substantially similar to limitation [1e]. Thus, for the reasons discussed for

limitation [1e], it is my opinion that *You* alone or further in view of *Liu* teaches this limitation.

g. [6f]: “the first radio signal carries a paging message;”

164. As shown by the claim comparison in Section VII.B, limitation [6f] is substantially similar to limitation [1f]. Thus, for the reasons discussed for limitation [1f], it is my opinion that *You* discloses this limitation.

h. [6g]: “the frequency domain resource used for transmitting the first signaling belongs to a first subband;”

165. As shown by the claim comparison in Section VII.B, limitation [6g] is substantially similar to limitation [1g]. Thus, for the reasons discussed for limitation [1g], it is my opinion that *You* discloses this limitation.

i. [6h]: “the first subband comprises a positive integer number of consecutive subcarriers in frequency domain; and”

166. As shown by the claim comparison in Section VII.B, limitation [6h] is substantially similar to limitation [1h]. Thus, for the reasons discussed for limitation [1h], it is my opinion that *You* discloses this limitation.

j. [6i]: “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.”

167. As shown by the claim comparison in Section VII.B, limitation [6i] is substantially similar to limitation [1i]. Thus, for the reasons discussed for

limitation [1i], it is my opinion that *You* in view of *Liu* teaches this limitation.

8. Claim 9

- a. [9a]: “The method according to claim 6, further comprising: transmitting a second radio signal;”**

168. As shown by the claim comparison in Section VII.B, limitation [9a] is substantially similar to limitation [4a]. Thus, for the reasons discussed for limitation [4a], it is my opinion that *You* in view of *Liu* teaches this limitation.

- a. [9b]: “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}.”**

169. As shown by the claim comparison in Section VII.B, limitation [9b] is substantially similar to limitation [4b]. Thus, for the reasons discussed for limitation [4b], it is my opinion that *You* in view of *Liu* teaches this limitation.

9. Claim 10

- a. [10a]: “The method according to claim 6, further comprising: transmitting a second signaling;”**

170. As shown by the claim comparison in Section VII.B, limitation [10a] is substantially similar to limitation [5a]. Thus, for the reasons discussed for limitation [5a], it is my opinion that *You* discloses this limitation.

b. [10b]: “wherein the second signaling is used for determining Q subbands, Q being a positive integer;”

171. As shown by the claim comparison in Section VII.B, limitation [10b] is substantially similar to limitation [5b]. Thus, for the reasons discussed for limitation [5b], it is my opinion that *You* discloses this limitation.

c. [10c]: “the first subband belongs to one of the Q subbands;”

172. As shown by the claim comparison in Section VII.B, limitation [10c] is substantially similar to limitation [5c]. Thus, for the reasons discussed for limitation [5c], it is my opinion that *You* discloses this limitation.

d. [10d]: “any one of the Q subbands comprises a positive integer number of consecutive subcarriers; and”

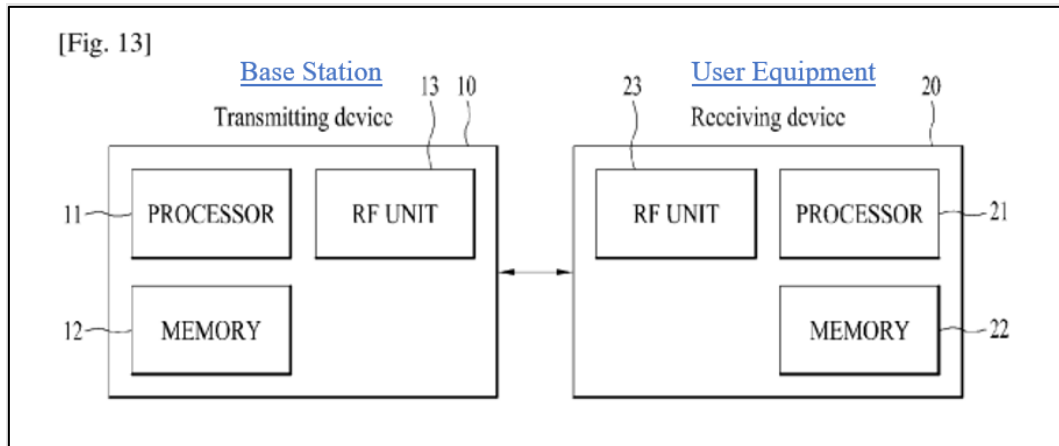
173. As shown by the claim comparison in Section VII.B, limitation [10d] is substantially similar to limitation [5d]. Thus, for the reasons discussed for limitation [5d], it is my opinion that *You* discloses this limitation.

e. [10e]: “the feature ID of the monitor of the first signaling is used for determining the first subband in the Q subbands.”

174. As shown by the claim comparison in Section VII.B, limitation [10e] is substantially similar to limitation [5e]. Thus, for the reasons discussed for limitation [5e], it is my opinion that *You* discloses this limitation.

10. Claims 11, 14, and 15

175. As shown by the claim comparison in Section VII.B, independent claim 11 is substantially similar to claim 1, except it is an apparatus claim directed to “[a] UE for paging,” and requires: (1) “a first receiver module” to monitor a first radio signaling in X time intervals, and (2) “a second receiver module” to receive a first radio signal. *You* discloses or suggests these apparatus-related limitations.
176. Figure 13 of *You* discloses a wireless communication system including “a transmitting device 10 and a receiving device 20,” in which a UE operates as the receiving device 20 for a downlink transmission. *You*, [285], [292]. *You* discloses that the receiving device 20 includes a radio frequency (RF) unit 23 capable of receiving radio signals carrying information, data, signals, and/or messages; a memory 22 for storing information related to communication in a wireless communication system; and a processor 21 configured to control the memory 22 and/or the RF unit 23 so that the receiving device 20 may perform the disclosed methods. *Id.*, [286]. The processor 21 controls the RF unit 23 to receive radio signals transmitted by the transmitting device 10. *Id.*, [290]. The processor 21 also decodes and demodulates the received radio signals. *Id.*



Id., Fig. 13.

a. “A UE for paging”

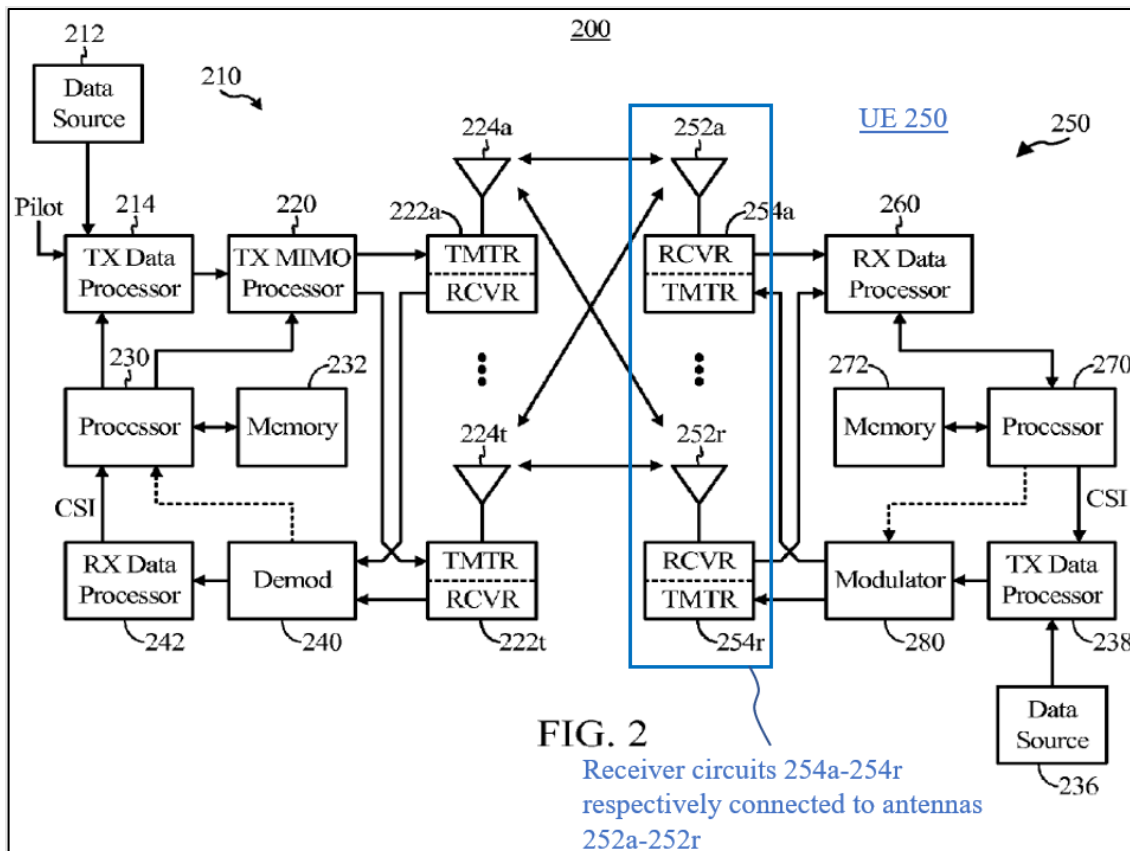
177. *You*’s receiving device 20 constitutes the “UE for paging” recited in claim 11, because *You* discloses that the receiving device 20 is used for implementing the disclosed paging method. *Id.*, [285] (“a receiving device 20 for implementing the present invention”), [293] (“[t]he UE processor of the present invention may control the UE RF unit to receive configuration or reconfiguration information on CSS_paging from the eNB”).

b. “a first receiver module” and “a second receiver module”

178. In my opinion, *You*’s RF unit 23 discloses or at least renders obvious the claimed “first receiver module” and “second receiver module.” Specifically, *You* discloses that the receiving device 20’s RF unit 23 includes multiple receive antennas to support a multiple input multiple output (MIMO) function. *You*, [291] (“An RF unit supporting a MIMO function of

transmitting and receiving data using a plurality of antennas may be connected to two or more antennas.”). *You* further discloses that the RF unit 23 “frequency down-converts each signal received through receive antennas into a baseband signal.” *Id.*, [290]. In my opinion, a POSA would have understood that the frequency down-conversion is performed by a receiver circuit. Moreover, a POSA would have found it obvious to include multiple receiver circuits respectively connected to the multiple receive antennas, each receiver circuit being used for down-converting the signal received from the respective receive antenna. *Vitthaladevuni*, Fig. 10, [0119] (“The transmitted modulated signals are received by NR antennas 1061a through 1061r and the received signal from each antenna 1061 is provided to a respective receiver (RCVR) 1062a through 1062r. Each receiver 1062 may condition (e.g., filter, amplify and down-convert) a respective received signal.”). Such parallel processing of the antenna signals, *see Luo*, Fig. 2 (showing one receiver at each antenna), would allow *You*’s processor 21 to simultaneously decode and demodulate the signals received from multiple receive antennas, thereby improving the speed, range, reliability and throughput capability of the receiver. *Id.*, [0037]-[0038]; *see also id.*, Fig. 2 (showing antennas 224a and 224t, each having a transmitter, sending signals received by antennas 252a and 252r, each having a receiver); *Vitthaladevuni*,

Fig. 10 (showing antennas 1056a and 1056t, each having a transmitter, sending signals received by antennas 1061a and 1061r, each having a receiver); *Hu*, Fig. 12 (showing antennas 1524A and 1524T, each having a transmitter, sending signals received by antennas 1522A and 1522R, each having a receiver). *You*'s processor also only decodes the Y time intervals that contain the X time intervals, thereby prolonging battery life.



Luo, Fig. 2.

179. Therefore, *You* discloses or at least renders obvious multiple receiver modules, each including a receive antenna and an associated receiver circuit.
- In my opinion, a POSA would have reasonably expected to succeed in

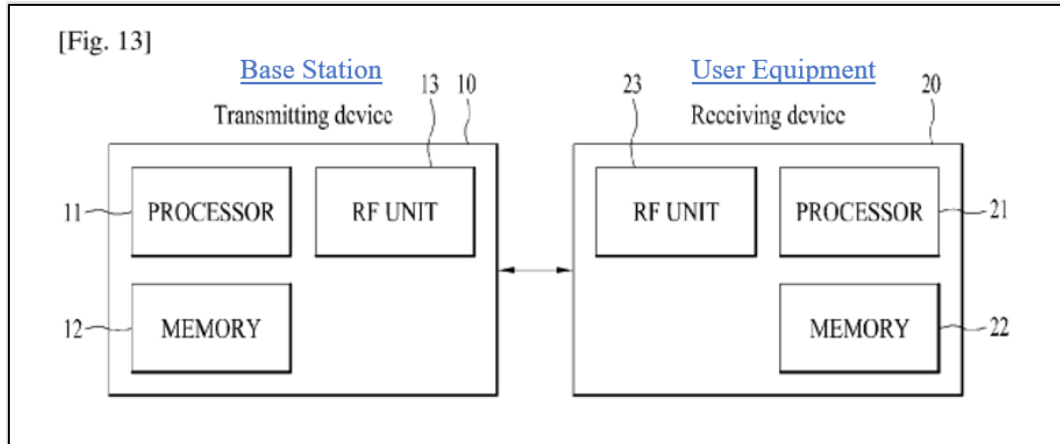
providing two receiver modules, each receiving the claimed “first radio signaling” and “first radio signal” respectively, in *You*’s UE because multiple receiver modules receiving these signals were conventional and routine in the MIMO antennas described in *You*. *Luo*, Fig. 2; *Vitthaladevuni*, Fig. 10; *Hu*, Fig. 12. As such, the combination represents nothing more than known components operating according to their ordinary and expected functions to yield predictable results (receiving signals).

c. Remaining limitations of claims 11, 14, and 15

180. Given the similarity between claims 1 and 11 (*see* claim comparison in Section VII.B), the remaining features of claim 11 are respectively disclosed or suggested for the same reasons discussed above regarding the corresponding features of claim 1 in Sections IX.A.4.b through IX.A.4.j.
181. Similarly, as shown by the claim comparison in Section VII.B, claims 4 and 14, and 5 and 15 are respectively similar to one another and are obvious for the same reasons discussed in Sections IX.A.5 and IX.A.6 respectively. Additionally, “the first receiver module” recited in claims 14 and 15 is disclosed or at least rendered obvious by *You* for the same reasons discussed in Section IX.A.10.b.

11. Claims 16, 19, and 20

182. As shown by the claim comparison in Section VII.B, independent claim 16 is substantially similar to claim 6, except it is an apparatus claim directed to a base station for paging, and requires: (1) “a first transmitter module” to transmit a first signaling in a positive integer number of time intervals of X time intervals, and (2) “a second transmitter module” to transmit a first radio signal. *You* discloses or suggests these apparatus-related limitations.
183. Figure 13 of *You* discloses a wireless communication system including “a transmitting device 10 and a receiving device 20,” in which a base station operates as the transmitting device 10 in a downlink transmission. *You*, [285], [292]. *You* discloses that the transmitting device 10 includes a radio frequency (RF) unit 13 capable of transmitting radio signals carrying information, data, signals, and/or messages; a memory 12 for storing information related to communication in a wireless communication system; and a processor 11 configured to control the memory 12 and/or the RF unit 13 so that the transmitting device 10 may perform the disclosed methods. *Id.*, [286]. The processor 11 performs coding and modulation for a signal and/or data scheduled to be transmitted to the outside, and then transfers the coded and modulated data to the RF unit 13. *Id.*, [289].



You, Fig. 13.

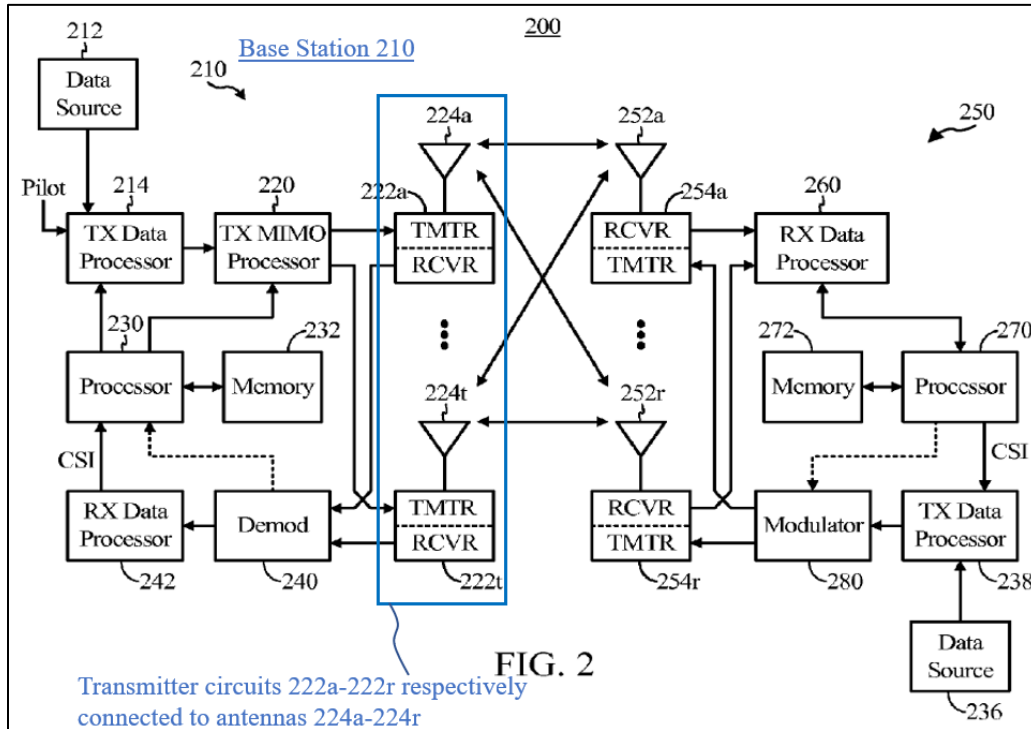
a. “A base station for paging”

184. *You*’s transmitting device 10 constitutes the “base station for paging” recited in claim 16, because *You* discloses that the transmitting device 10 is used for implementing the disclosed paging method. *Id.*, [285] (“a transmitting device 10 . . . for implementing the present invention”), [293] (“[t]he eNB processor of the present invention may configure or reconfigure CSS_paging”).

b. “a first transmitter module” and “a second transmitter module”

185. In my opinion, *You*’s RF unit 13 discloses or renders obvious the claimed “a first transmitter module” and “a second transmitter module.” Specifically, *You* discloses that the transmitting device 10’s RF unit 13 includes multiple transmit antennas to support a multiple input multiple output (MIMO) function. *You*, [291] (“An RF unit supporting a MIMO function of

transmitting and receiving data using a plurality of antennas may be connected to two or more antennas.”). *You* further discloses that the RF unit 13 includes “an oscillator” that performs “frequency up-conversion” to provide signals to be transmitted by the transmit antennas. *Id.*, [289]. In my opinion, a POSA would have found it obvious to include multiple oscillators (i.e., transmitter circuits) respectively connected to the multiple transmit antennas, each oscillator being used for up-converting signals for the respective transmit antenna. *Vitthaladevuni*, Fig. 10, [0118] –[0119] (“The transmit (TX) multiple-input-multiple-output (MIMO) processor 1054 then provides NT modulation symbol streams to NT transmitters (TMTR) 1055a through 1055t . . . Each transmitter 1055 may receive and process a respective symbol stream to provide one or more analog signals, and further condition (e.g., amplify, filter and upconvert) the analog signals to provide a modulated signal suitable for transmission over the MIMO channel”). Because *You*’s oscillator is slower than the processor 11 and usually the speed bottleneck, the parallel arrangement of the oscillator-antenna pairs, *see Luo*, Fig. 2 (showing one transmitter circuit at each antenna), allows simultaneous frequency up-conversion for the multiple transmit antennas, thereby improving the speed, range, reliability, and throughput of the transmitter. *Id.*, [0035]-[0036].



Luo, Fig. 2.

186. Therefore, *You* discloses or at least renders obvious multiple transmitter modules, each including a transmit antenna and an associated oscillator. In my opinion, a POSA would have reasonably expected to succeed in providing two transmitter modules, each transmitting the claimed “first signaling” and “first radio signal” respectively, in *You*’s base station because multiple transmitter modules transmitting these signals were conventional and routine for the MIMO systems described in *You*. Luo, Fig. 2; Vitthaladevuni, Fig. 10; Hu, Fig. 12. As such, the combination represents nothing more than known components operating according to their ordinary and expected functions to yield predictable results (transmitting signals).

c. Remaining limitations of claims 16, 19, and 20

187. Given the similarity between claims 6 and 16 (*see* claim comparison in Section VII.B), the remaining features of claim 16 are respectively disclosed or suggested for the same reasons discussed above for the corresponding features of claim 6 in Sections IX.A.7.b through IX.A.7.j.
188. Similarly, as shown by the claim comparison in Section VII.B, claims 9 and 19, and 10 and 20 are respectively similar to one another and are obvious for the same reasons discussed in Sections IX.A.8 and IX.A.9 respectively. Additionally, “the first transmitter module” recited in claims 19 and 20 is disclosed or at least rendered obvious by *You* for the same reasons discussed in Section IX.A.11.b.

B. Claims 2, 3, 7, 8, 12, 13, 17, and 18 Are Obvious Over *You*, *Liu*, and *Mallick* (Ground 2)

1. Overview of *Mallick*

189. Same as *You*, *Mallick* relates to using coverage extension (CE) technique to page MTC devices. *Mallick*, Abstract, [0140]-[0141], [0145].⁷ *Mallick* recognizes that the CE requires repeated transmission of paging control information and/or increased power, imposing a heavier burden on the base

⁷ *Mallick* explains that “[c]overage [e]xtension” is another term for coverage enhancement. *Mallick*, [0060].

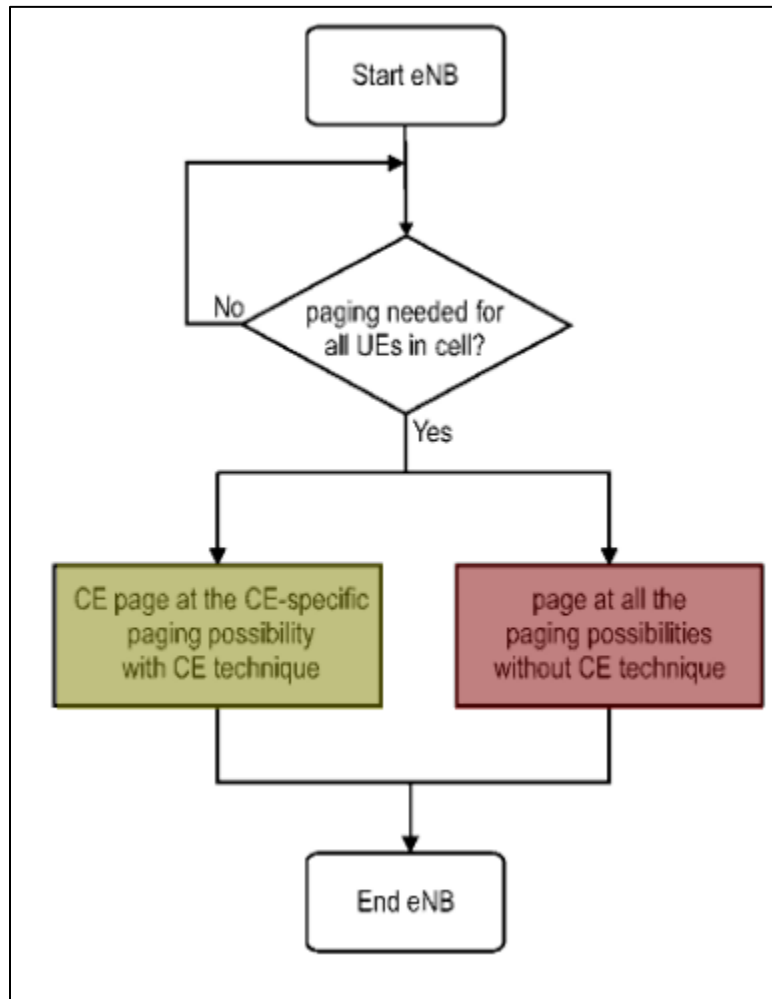
station than the normal coverage. *Id.*, [0072], [0078], [0151]. To alleviate this problem, instead of indiscriminately applying the CE to all the UEs in a cell and at all the possible paging occasions, *Mallick* proposes limiting CE to only a selected group of UEs at a subset of the paging occasions. *Id.*, [0160].

190. Specifically, the UEs in a cell covered by a base station are divided into UEs that experience bad radio conditions and thus require CE (“CE-UEs”), and normal UEs that do not require CE (“non-CE-UEs”). *Id.*, [0075], [0135]. As shown in Figure 7, the base station (i.e., eNB) may page all the UEs in its cell (including the CE-UEs and non-CE-UEs) at **UE-specific paging possibilities, without using the CE technique**. *Id.*, [0146], [0159].

Additionally, the eNB also pages the CE-UEs at **CE-specific paging possibilities, by using the CE technique**. *Id.* The term “paging possibility” refers to the combination of a paging frame (i.e., a radio frame) and a paging occasion (i.e., one or more subframes within the paging frame). [0024], [0072], [0148], [0161].

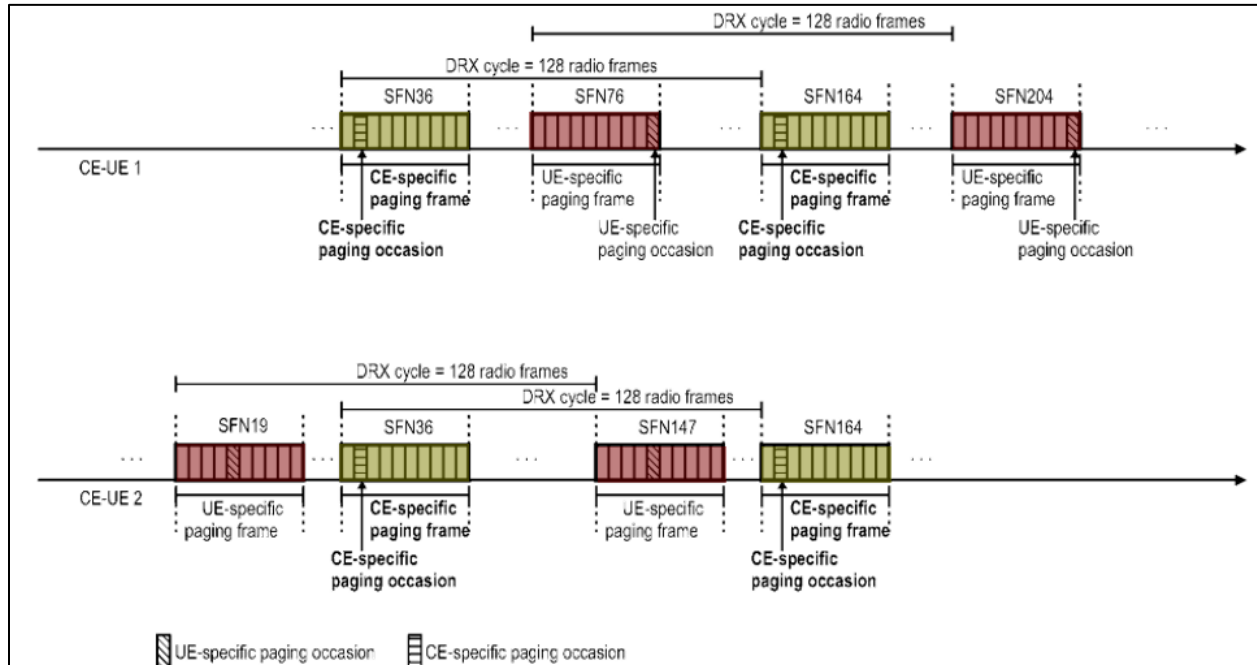
191. The **UE-specific paging possibilities** are determined based on the ordinary UE identifiers (UE-specific IDs), in the same way defined in the 4G/LTE standards, and thus are specific to the UEs. *Id.*, [0025]-[0029], [0148]. The UE-specific IDs may be the UE’s real IMSIs (International Mobile Subscriber Identity). *Id.*, [0025], [0043], [0137], [0170].

192. Moreover, the CE-specific paging possibilities may be determined based on a CE-specific ID common to the CE-UEs, and thus are the same for all the CE-UEs. *Id.*, [0079], [0093], [0101], [0107], [0148], [0169]-[0170], claim 5. The CE-specific ID may be a CE-IMSI independent from the UEs' real IMSI. *Id.*, [0169]-[0170]. In some embodiments, "[w]hen considering the various CE levels," the CE-specific ID may include multiple CE-level-specific IDs respectively defined for different CE levels, "such that a CE-UE will only monitor the CE-level-specific paging possibility of the CE-level for which it is configured but not other CE-level-specific paging possibilities that are defined for other CE-level." *Id.*, [0169], [0172].



Id., Fig. 7.

193. Figure 5 shows the above process from the UEs' perspective. *Id.*, [0157]-[0158]. Specifically, two CE-specific UEs monitor the normal paging PDCCHs at different **UE-specific paging possibilities**, and monitor the CE paging PDCCHs at the same **CE-specific paging possibilities**. *Id.* Although not shown in Figure 5, *Mallick* explains that the non-CE-UEs only monitor the normal paging PDCCHs at their respective **UE-specific paging possibilities**. *Id.*, [0148], [0154].



Id., Fig. 5.

194. By limiting the CE to the **CE-specific paging possibilities**, the downlink resources can be saved and the burden on the base station can be reduced.

Id., [0078], [0160], [0174]-[0175].

195. In my opinion, *Mallick* is analogous art to the '767 patent because *Mallick*, like the '767 patent, discloses methods for a UE to monitor paging scheduling information for a number of times. In particular, *Mallick* discloses a method that “involve[s] repeating the transmission of both paging messages, i.e. the paging notification on the PDCCH and the actual paging message on the PDSCH, for a pre-configured number of times” *Mallick*, [0139]; *id.*, [0001], [0152]. This is just like the '767 patent's disclosure about monitoring the “first signaling” (i.e., paging scheduling

information) in “X time intervals.” ’767 patent, Abstract, 2:20-32, 3:7-8, 3:54-55.

2. Rationale for combining *You/Liu* with *Mallick*

196. In my opinion, a POSA would have been motivated to combine *You/Liu* with *Mallick*’s improved CE paging procedure, including its teachings about how to determine the UE-specific paging possibilities and CE-specific paging possibilities.
197. Particularly, *Mallick* is within the same field and directed to similar problems of *You/Liu*. All three references are directed to paging/DRX procedure in MTC UEs that are compliant with 3GPP 4G/LTE or 5G/NR standards. *You*, [41], [180], [188]; *Liu*, [0002], [0004]; *Mallick*, Abstract, [0143], [0145]; 767 patent, 1:45-47, 5:1-3. Moreover, both *You* and *Mallick* pertain to using the CE technique in paging. *You*, [174]; *Mallick*, Abstract. Because of the many common teachings shared by these references, a POSA would have considered *Mallick*’s teachings to be relevant to configuring *You/Liu*.
198. Moreover, a POSA would have been motivated to use *Mallick*’s design of CE-specific paging possibilities to improve *You/Liu*. As discussed in Section IX.B.1, *Mallick* discloses that limiting the CE to CE-UEs and the CE-specific paging possibilities has the advantage of saving the downlink

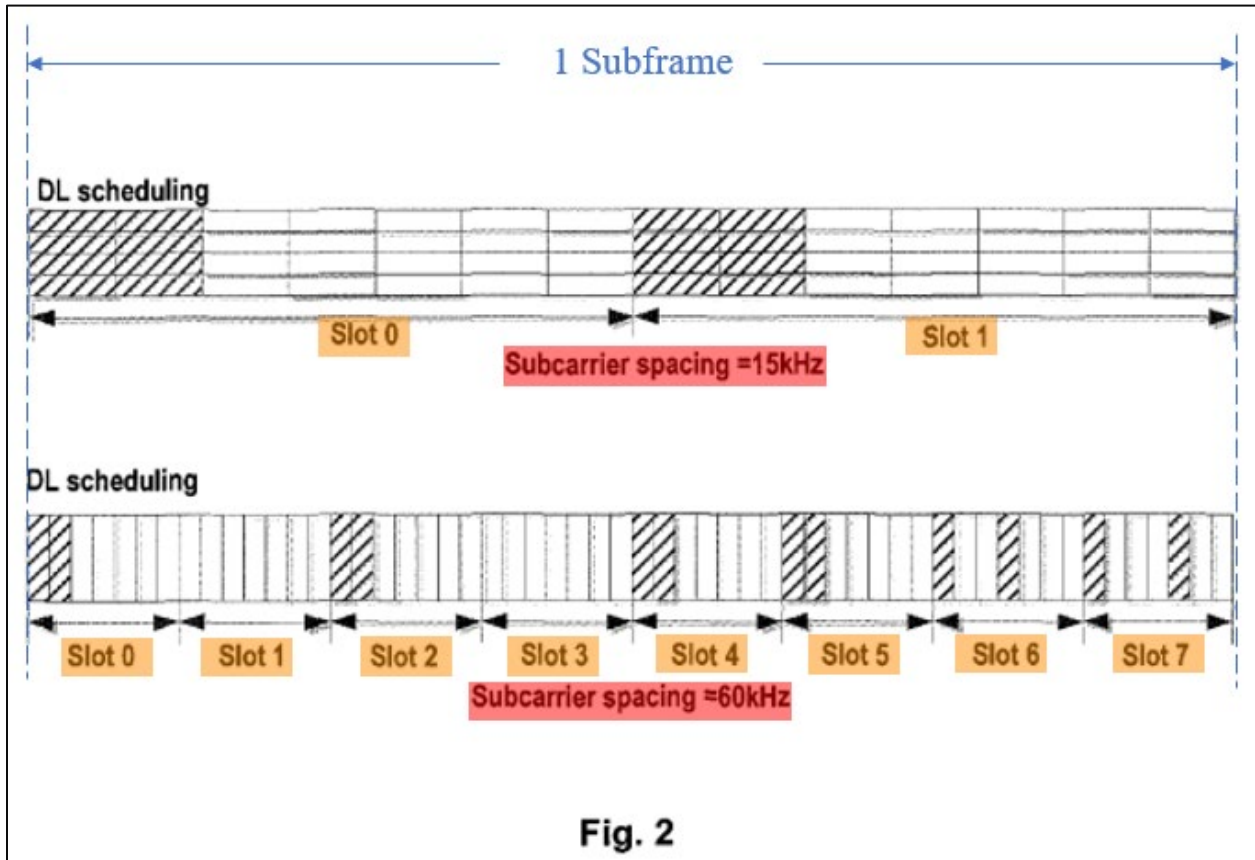
resources and reducing the burden on the base station. *Mallick*, [0078], [0160], [0174]-[0175]. Moreover, for a higher granularity, *Mallick*'s CE-specific paging possibilities can be further classified according to the CE levels, such that a CE-UE can skip monitoring the CE-specific paging possibilities not associated with its CE level, thereby reducing the CE-UE's power consumption. *Id.*, [00169]-[0172]. On the other hand, as discussed in Section IX.A.1, *You* discloses that a UE may be paged with or without CE, and not all UEs require the same level of CE. *You*, [0179], [0186]-[0187]. Thus, in my opinion, *You*'s CE paging method is ready for improvement according to *Mallick* advantageous design.

199. Moreover, a POSA would have expected the combination of *You/Liu* and *Mallick* to yield predictable results because it only requires combining elements according to known methods. *You* discloses "a CSS starting subframe may mean a first subframe of paging occasions for allowing a UE to monitor M-PDCCH for a paging message." *You*, [186]. *You*, however, does not disclose how a UE can determine the CSS starting subframe, despite that information being necessary to determining the "CSS monitoring opportunities within a paging occasion." *Id.*, [196]. To that end, *Mallick* supplements the background knowledge about how *You*'s UE determines the CSS starting subframe in 4G CE mode, namely, using the

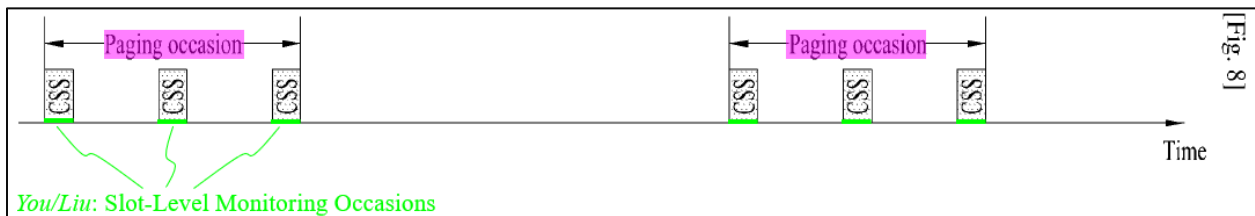
formula “ $\text{SFN mod } T = (T \text{ div } N) * (\text{UE_ID mod } N)$ ” to determine the paging frame number SFN, and using “ $i_s = \text{floor}(\text{UE_ID}/N) \text{ mod } N_s$ ” to determine the paging occasion index i_s . *Id.*, [0025], [0027]. A POSA would have understood that the i_s specifies which subframe of the paging frame is the starting subframe of the paging occasion. *Id.*, [0029]-[0030].

200. Although presented as a solution for 5G/NR, *Liu* does not change the way *You/Mallick* (i.e., 4G/LTE) determines paging frames and paging occasions. First, *Liu*’s Figure 2, below, shows that the subframe duration is independent from the numerologies. *See also, supra*, FN 5. It follows that the frame duration, which is a multiple of subframe durations, is also independent from the numerologies. *Supra*, Section VI.B.3. Thus, the flexible numerology in *Liu* and 5G/NR would not disturb the existing way of arranging frames (paging frames) and subframes (paging occasions) in paging cycles. Second, *You*’s Figure 8, as modified below, shows that the *You/Liu* combination’s slot-level monitoring solution only changes how the monitoring occasions are distributed within a paging occasion, but does not affect the subframe-level (paging occasion level) or frame-level (paging frame level) structures. Accordingly, a POSA would have understood that *Mallick*’s 4G/LTE method of determining paging occasion and paging frame can be applied to *You/Liu* in the same way, and would have expected such combination to

yield the same solution contemplated by the '767 patent. *Compare Mallick*,
[0024]-[0025], *with* '767 patent, 5:15-19.



Liu, Fig. 2.



You, Fig. 8.

3. Claim 2

- a. [2a]: “The method according to claim 1, wherein any one of the **X time intervals** belongs to a **first time window** in time domain;”

201. *You* in view of *Liu* teaches claim 1 and this additional limitation. As discussed in Section IX.A.3.b, *You/Liu* teaches that the **M-PDCCH/DCI monitoring occasions** belong to a paging occasion. *You*, [199]-[200]; *Liu*, [0004], [0044], [0046]. *You* further discloses that the paging occasion belongs to a **paging frame**, which is also a **radio frame**. *You*, [191] (“A paging frame (PF) means one radio frame that includes one or a plurality of paging occasion(s).”); *see also Mallick*, [0024] (“A Paging Frame (PF) is a radio frame, which may contain one or multiple Paging Occasion(s).”). It follows that the **M-PDCCH/DCI monitoring occasions** belong to a **paging frame**.

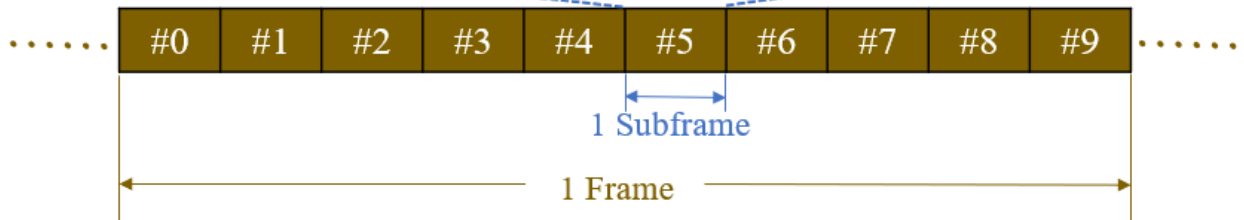
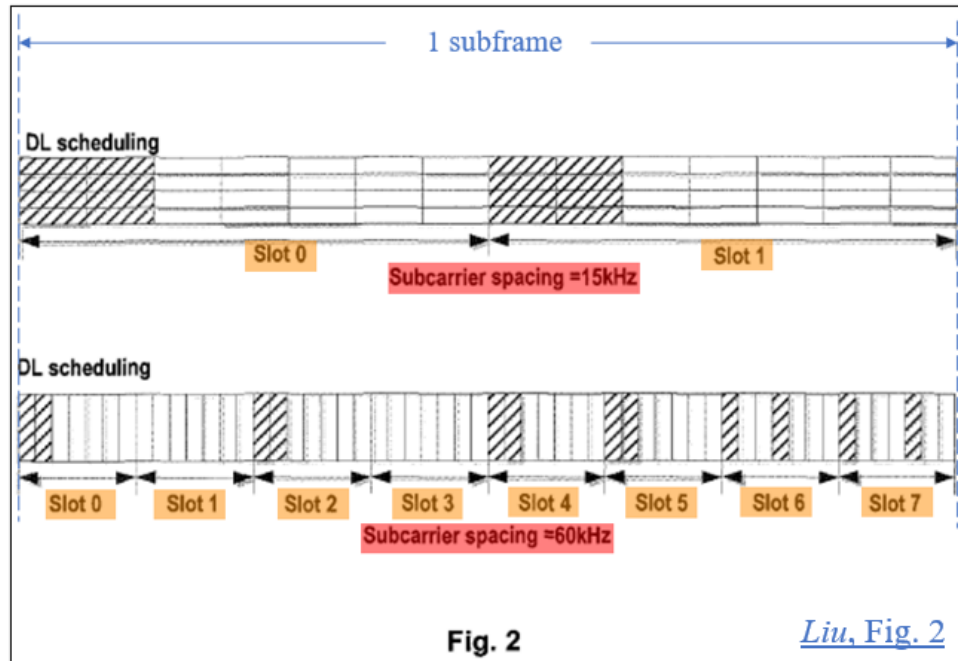
- b. [2b]: “the time length of the **first time window** is predefined;”

202. *You* in view of *Liu* teaches this limitation. As discussed for limitation [2a], *You* discloses that the **paging frame** is a **radio frame**. Further, *You* discloses that “a 3GPP LTE/LTE-A **radio frame** is 10ms (307,200T_s) in duration.” *You*, [52]. The *You/Liu* combination does not change this predefined frame duration because *Liu*’s slot-level transmission/monitoring does not change the subframe duration, let alone the subframe-frame hierarchy. FN 5. Indeed,

5G/NR's flexible numerology does not require the frame duration to be changed because, even before the time of *Liu*, members of the 3GPP working group had contemplated to keep using the same 10ms frame duration in the then-proposed 5G network. *Parkvall*, [1033] ("As an example, a System Frame Number (SFN) length of 16 bits may be used, which would allow a 10 minutes DRX given a radio frame length of 10 ms."). Thus, *You/Liu* teaches that the time length of the **paging frame** is predefined.

c. **[2c]: "the first time window is divided into Y time intervals;"**

203. *You* in view of *Liu* teaches this limitation. *You* discloses that a **radio frame** is divided into 10 subframes. *You*, [52]. Moreover, as I show below using *Liu*'s Figure 2, *Liu* discloses that a subframe is divided into **2 slots** under **15kHz subcarrier spacing**, and **8 slots** under **60kHz subcarrier spacing**. *Liu*, Fig. 2. It follows that *You* in view of *Liu* teaches that a **radio frame** is divided into various numbers of **slots** depending on the **subcarrier spacing** (e.g., **20 slots** under **15kHz subcarrier spacing**, and **80 slots** under **60kHz subcarrier spacing**). Moreover, for the reasons discussed in Section IX.A.3, it would have been obvious to combine the teachings of *You* and *Liu*.

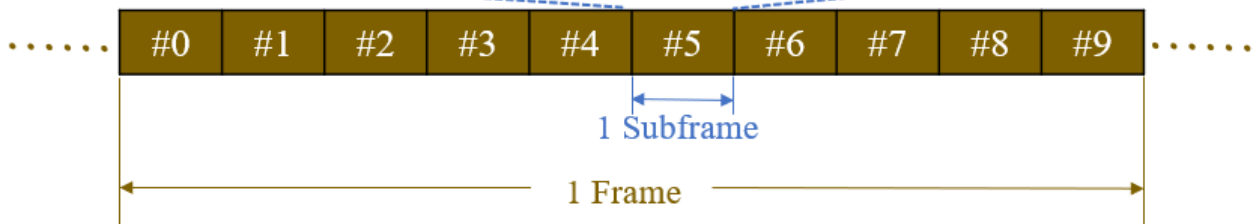
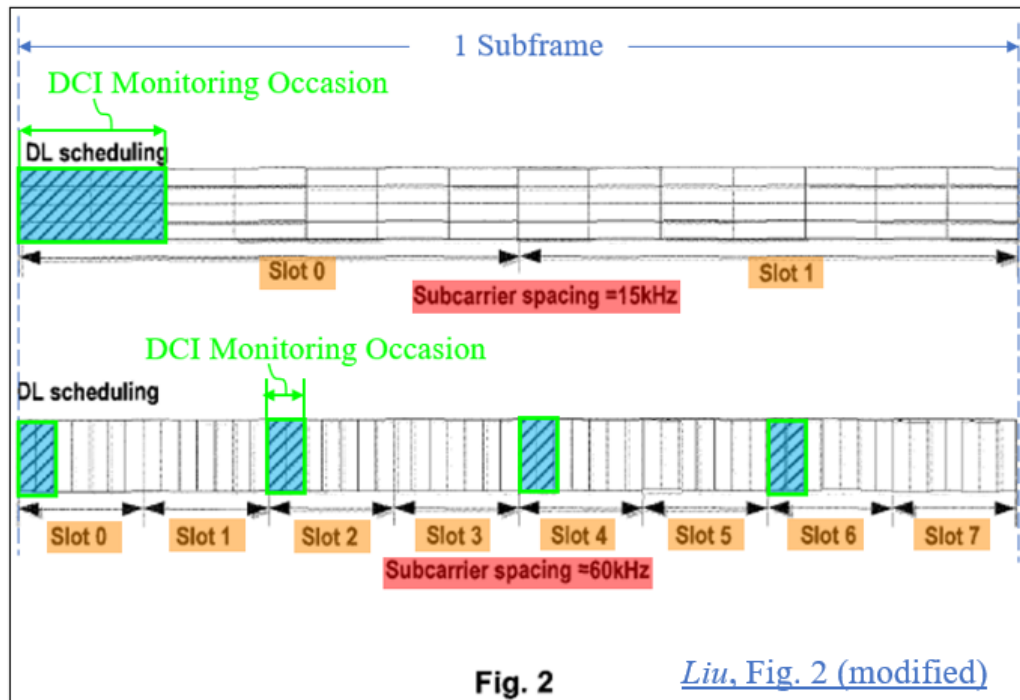


Liu, Fig. 2.

- d. [2d]: “the **X time intervals** are **X time intervals** of the **Y time intervals**, Y being a positive integer not smaller than X;”

204. You in view of *Liu* teaches this limitation. As shown in the drawings below, You/*Liu* teaches that each **PDCCH/DCI monitoring occasion** is in a respective **slot**. *Supra*, Section IX.A.3.b. Moreover, in You/*Liu*’s slot-level transmission/monitoring, the **PDCCH/DCI monitoring occasions** are repeated per **slot** or per **multi-slots**. *Liu*, [0048]-[0049]. Thus, the number of the **slots** is not smaller than the number of the **PDCCH/DCI monitoring**

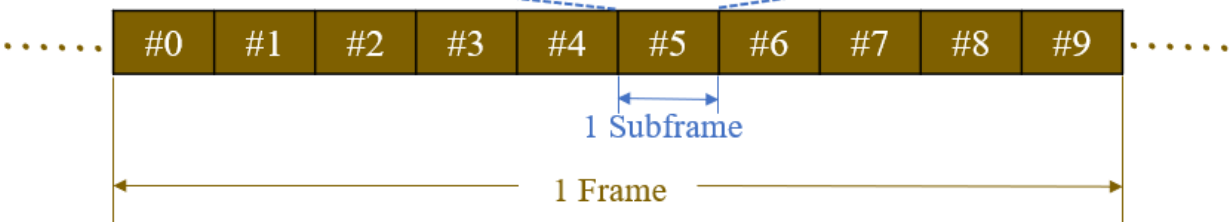
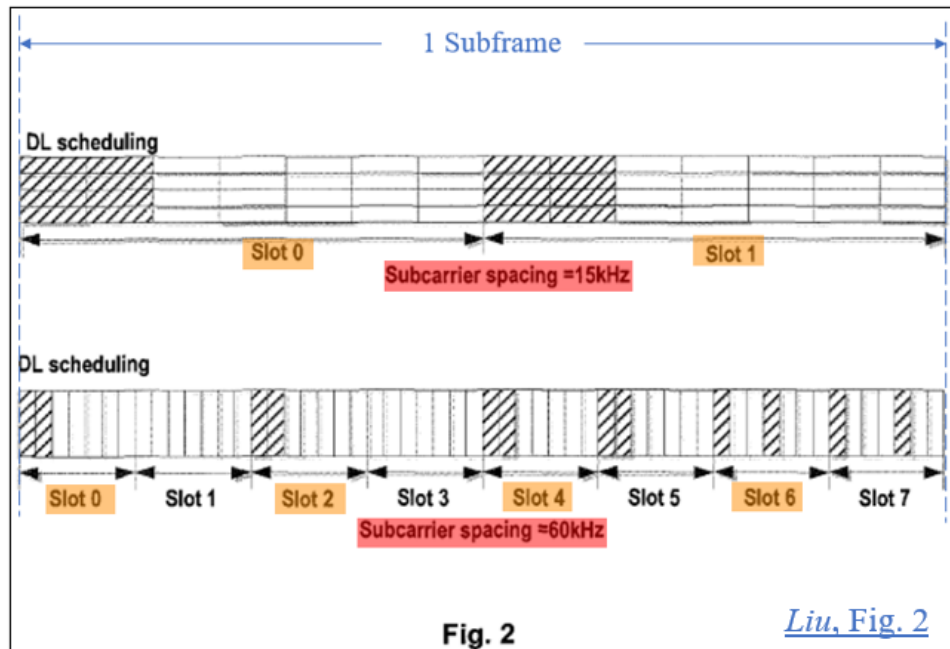
occasions. Finally, for the reasons discussed in Section IX.A.3, it would have been obvious to combine the teachings of *You* and *Liu* such that the PDCCH/DCI monitoring occasions are located in one or more slots of the paging frame.



Liu, Fig. 2.

e. [2e]: “the **subcarrier spacing** of subcarriers included in the first subband is used for determining **Y**; and”

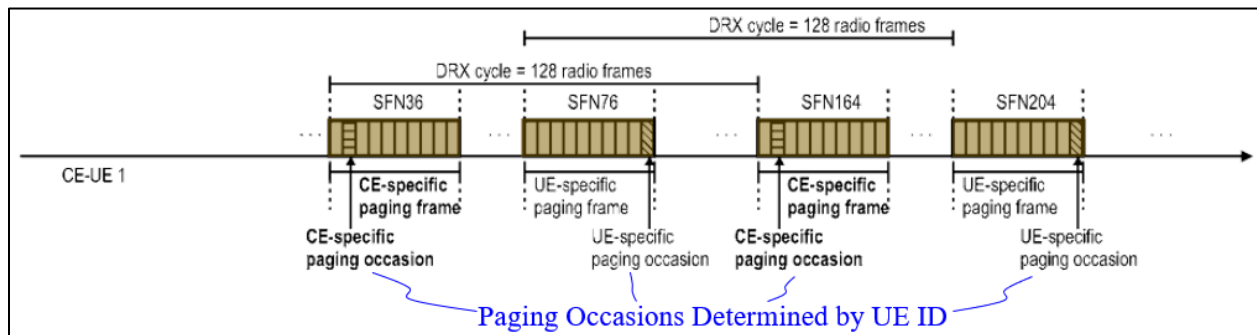
205. For the reasons discussed for limitation [2c], *You* in view of *Liu* teaches that the number (Y) of the slots in a radio frame depends on the subcarrier spacing.



Liu, Fig. 2.

- f. [2f]: “a **feature ID** of a monitor of the **first signaling** is used for determining the **X time intervals** in the **Y time intervals**.”

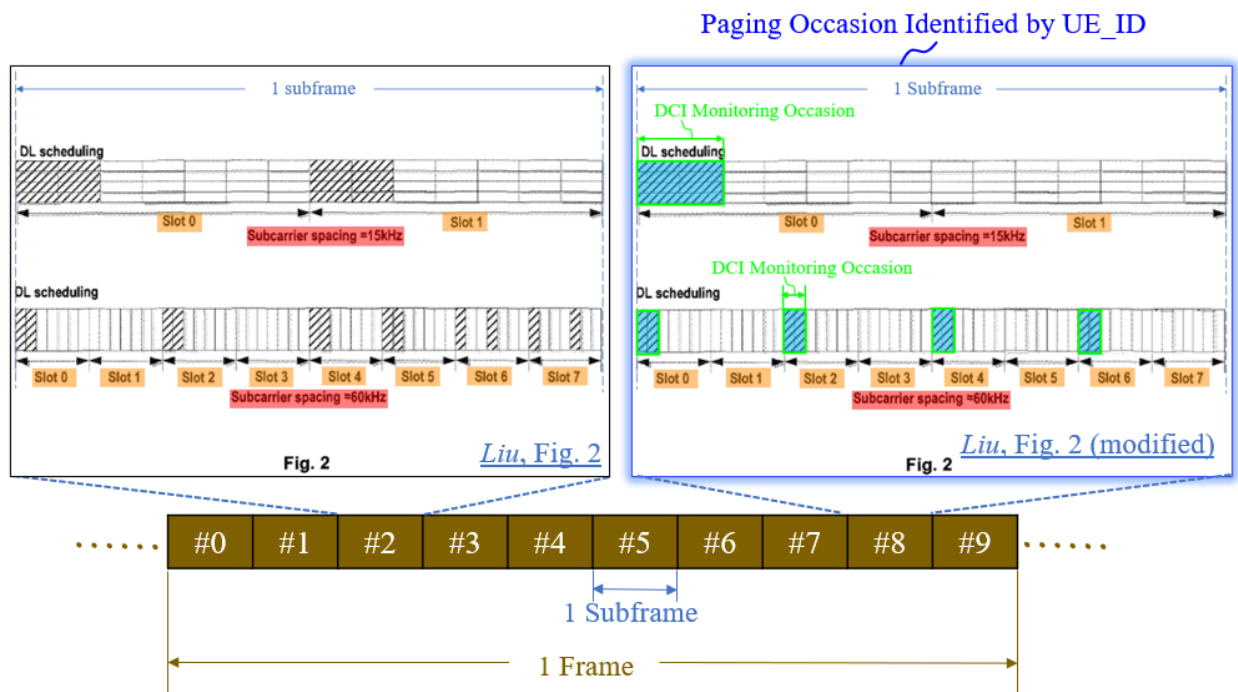
206. You in view of *Liu* and *Mallick* teaches this limitation. As discussed for limitation [1a], You discloses a UE for “monitoring a **first signaling**,” as claimed. You, [185]-[187], [199]. Moreover, *Mallick* discloses the claimed “**feature ID** of a monitor of the **first signaling**” by disclosing a **UE ID** (e.g., a UE-specific ID associated with a non-CE-UE or CE-UE, or a CE-specific ID associated with a CE-UE) that is used for determining a paging occasion in a **paging frame**. *Mallick*, [0027], [0170]. *Mallick* discloses that the “[p]aging [o]ccasion (PO) is a subframe” in the **paging frame**. *Id.*, [0024].



Id., Fig. 5 (excerpt).

207. As discussed for limitation [2c], You/*Liu* teaches that the **paging frame** is divided into **Y slots**; and as discussed for limitation [2a], You/*Liu* teaches that the **M-PDCCH monitoring occasions** belong to the paging occasion. Thus, the location (i.e., subframe number) of the paging occasion in the **paging frame** specifies which one(s) of the **Y slots** contain the **M-PDCCH**

monitoring occasions. Moreover, for the reasons discussed in Section IX.B.2, it would have been obvious for s POSA to apply *Mallick*'s teachings to *You/Liu*, to determine the location of the paging occasion in the paging frame based on the UE ID. *Id.*, [0027] (determining paging occasion index " $i_s = \text{floor}(\text{UE_ID}/N) \bmod N_s$ "). This combination is illustrated below—the UE ID is used to determine the paging occasion (i.e., the subframe containing the M-PDCCH monitoring occasions (e.g., subframe 8)) and thus the M-PDCCH monitoring occasions in the Y slots of paging frame (which contains the Y slots, including in other subframes (e.g., subframe 2)).

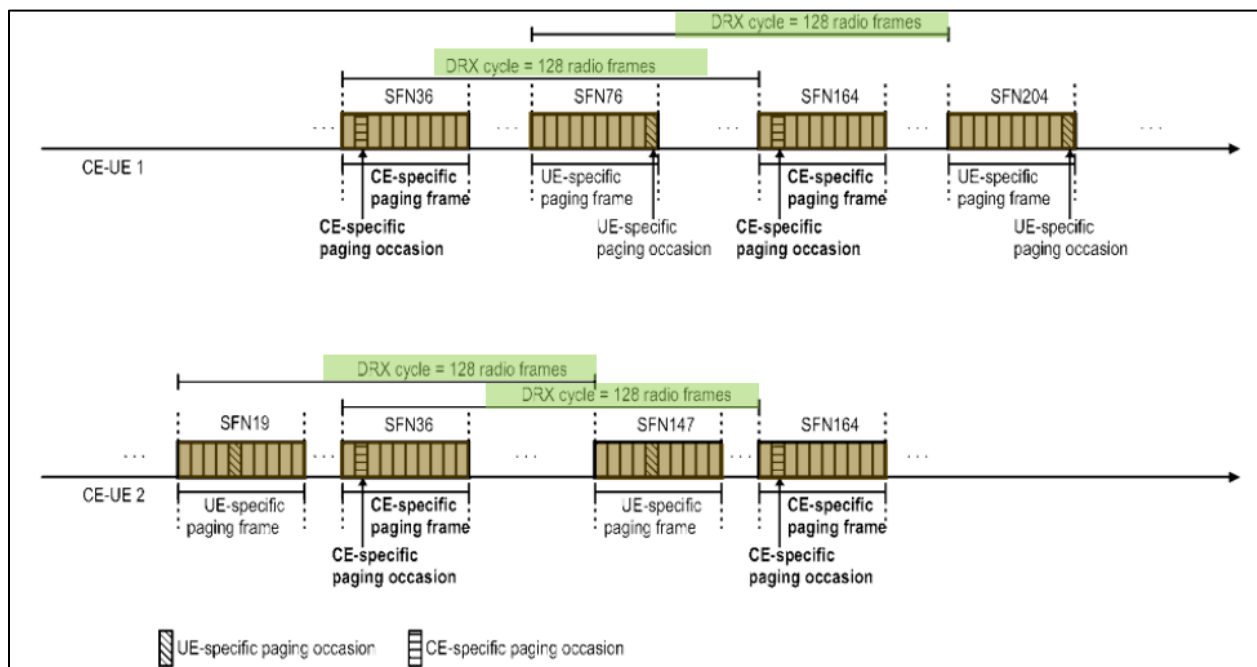


4. Claim 3

- a. [3a]: “The method according to claim 2, wherein the **first time window** belongs to one of **Z time windows**, Z being an integer greater than 1;”

208. You in view of *Liu* and *Mallick* teaches claim 2 and this additional limitation. As discussed for limitation [2a], You in view of *Liu* alone or further in view of *Mallick* teaches that the **X time intervals** belong to a **paging frame**. *Mallick* further discloses that the **paging frame** belongs to a **DRX cycle**, which contains a “default” **integer number** (e.g., 32, 64, 128 or 256) of **radio frames**. *Mallick*, [0038]; see also *id.*, [0019] (Table 1), [0022],

Fig. 5.



Id., Fig. 5.

209. Because a radio frame is a time window with a certain duration, *Mallick*'s **DRX cycle** discloses the claimed "**Z time windows**," with each **radio frame** in the **DRX cycle** constituting one of the claimed "**Z time windows**."
210. Moreover, *You* and *Mallick* each disclose that the **paging frame** is a radio frame. *You*, [191]; *Mallick*, [0024], [0134]. It follows that the **paging frame** is one of the **radio frames** in the **DRX cycle**.
211. Finally, for the reasons discussed in Section IX.B.2, it would have been obvious to apply *Mallick*'s teachings to *You/Liu*. Moreover, a POSA would have appreciated that a default setting is widely applicable, and thus would have had a reasonable expectation of success for using one of *Mallick*'s default paging cycles in *You/Liu*.

b. [3b]: "Z is predefined, or Z is configurable**;"**

212. *You* in view of *Liu* and *Mallick* teaches this limitation. *Mallick* discloses that the "[p]aging DRX cycle[] is the Discontinuous Reception (DRX) cycle configured in the UE (using NAS signalling) or the default DRX cycle broadcast in the System Information Block (SIB)." *Mallick*, [0038]; *see also id.*, [0017] ("Each cell broadcasts a default paging cycle T_c , and in addition, upper layers may use dedicated signaling to configure a UE-specific paging cycle T_{UE} ; if both are configured, the UE applies the lowest value for the DRX cycle T of the UE."). Thus, the **DRX cycle** can be a default (i.e.,

predefined) cycle for a cell and broadcast by an SIB message; or the DRX cycle can be a configurable cycle that is UE-specific and configured by upper layer signaling (e.g., NAS). Finally, for the reasons discussed in Section IX.B.2, it would have been obvious to apply *Mallick*'s teachings to *You/Liu*.

c. [3c]: “any two of the **Z time windows** have an equal time length; and”

213. *You* discloses this limitation by disclosing that **each radio frame in the DRX cycle** has a fixed duration of 10 ms. *You*, [52]. For the reasons discussed in Sections IX.B.2 and IX.B.3.b, *Liu*'s solution for 5G/NR does not change the existing **frame durations in the DRX cycle**.

d. [3d]: “the **feature ID** of the monitor of the **first signaling** is used for determining the **first time window** in the **Z time windows**.”

214. *You* in view of *Liu* and *Mallick* teaches this limitation. As discussed for limitation [2f], *Mallick* discloses the claimed “**feature ID**” by disclosing a **UE ID** that is used for determining a paging occasion in a **paging frame**. *Mallick* further discloses that the same **UE ID** can be used to determine the **paging frame** itself. Compare *Mallick*, [0025], with '767 patent, 5:15-19 (using substantially the same formula to determine “the **paging frame number (SFN)**” based on the “**UE_ID**”); *Mallick*, [0170]. Moreover, for the

reasons discussed in Section IX.B.2, it would have been obvious to apply *Mallick's* teachings to *You/Liu*..

5. Claim 7

215. Claim 7 depends from independent claim 6. Moreover, as shown by the claim comparison in Section VII.B, claim 7 is substantially similar to claim 2. Thus, for the reasons discussed for claims 6 and 2, it is my opinion that *You* in view of *Liu* and *Mallick* teaches claim 7.

6. Claim 8

216. Claim 8 depends from claim 7. Moreover, as shown by the claim comparison in Section VII.B, claim 8 is substantially similar to claim 3. For the reasons discussed for claims 6, 2, and 3, it is my opinion that *You* in view of *Liu* and *Mallick* teaches claim 8.

7. Claim 12

217. Claim 12 depends from independent claim 11. Moreover, as shown by the claim comparison in Section VII.B, claim 12 is substantially similar to claim 2. For the reasons discussed for claims 11 and 2, it is my opinion that *You* in view of *Liu* and *Mallick* teaches claim 12.

8. Claim 13

218. Claim 13 depends from claim 12. Moreover, as shown by the claim comparison in Section VII.B, claim 13 is substantially similar to claim 3. For

the reasons discussed for claims 11, 2, and 3, it is my opinion that *You* in view of *Liu* and *Mallick* teaches claim 13.

9. Claim 17

219. Claim 17 depends from independent claim 16. Moreover, as shown by the claim comparison in Section VII.B, claim 17 is substantially similar to claim 2. For the reasons discussed for claims 16 and 2, it is my opinion that *You* in view of *Liu* and *Mallick* teaches claim 17.

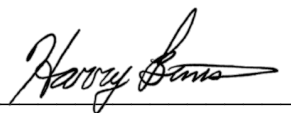
10. Claim 18

220. Claim 18 depends from claim 17. Moreover, as shown by the claim comparison in Section VII.B, claim 18 is substantially similar to claim 3. For the reasons discussed for claims 16, 2, and 3, it is my opinion that *You* in view of *Liu* and *Mallick* teaches claim 18.

X. CONCLUSION

221. 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.
222. I declare that all statements made herein of my 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 knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001.
223. I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Date: February 27, 2023

By: 

Harry V. Bims

Appendix A

Dr. Harry V. Bims
Protocomm Systems, LLC
2665 Marine Parkway, Suite 1140
Mountain View, CA 94043
harrybims@me.com
650-283-4174

PROFESSIONAL SUMMARY

Harry Bims, PhD, EE, provides expert witness support services for telecommunications-related intellectual property litigation. These services include deposition and court testimony, expert reports, and infringement research, for patent, copyright, and trade secret litigation matters. He has 30+ years of telecommunications industry experience, and holds twenty-two US patents in network architecture and chip design for wireless communications.

EMPLOYMENT HISTORY

12/2001 - 05/2004 AirFlow Networks, Inc. LLC • Sunnyvale, California

Position: *CEO/CTO & Founder*

As the sole founder of the company, created the original business plan, raised venture capital, and hired the core engineering team. Grew the company to 32 people and shipped products for revenue in the US and overseas. Fifteen patents on the core technology have issued. These patents, which relate to wireless network infrastructure based on the 802.11 specification, have been sold to Broadcom.

03/2001 - 12/2001 Bay Partners LLC • Cupertino, California

Position: *Entrepreneur in Residence*

Reported to the partners of this VC firm as a technology expert on a range of wireless and networking subjects. Reviewed business plans and participated in due diligence activities related to several startups seeking funding. Developed a business plan for a startup that builds network infrastructure for 802.11 enterprise networks.

09/1999 - 03/2001 Symmetry Communications Systems LLC • San Jose, California

Position: *Director, Software Architecture*

Reporting to the CEO, responsible for the software architecture of their core SGSN and GGSN products for the GPRS market. Formulated a software technology roadmap, showing the evolution from 2.5G to 3G SGSN and GGSN products. Management responsibility for Firmware, Hardware, Performance, and Systems Engineering Groups. Provided management support of early field trials of the system on a global basis.

07/1999 - 09/1999 **T-SPAN Systems Corporation LLC • Palo Alto, California**

Position: *Member of Technical Staff*

Designed a wireless home LAN protocol for the company. Also designed and built a PC-based platform to demonstrate their technology. Company is now publicly traded as Atheros Communications.

07/1992 - 12/1998 **Glenayre Technologies-Wireless Access Group • San Jose, California**

Position: *Member of Technical Staff; Sr. Member of Technical Staff; Manager of NOC Systems*

Employee #6 at the company, which was acquired by Glenayre Technologies, Nov 1997. Designed and built a 4-channel ReFLEX50 pager demonstration in 1 week. Participated in early field trials and feasibility studies, culminating in a Pioneer's Preference license award from the FCC to SkyTel Corporation for Narrowband PCS development.

Invented, designed, and built from concept through full implementation, a patented two-way pager test system for the ReFLEX50 and ReFLEX25 protocols. This system was used throughout company operations for performance testing of the ReFLEX pager designs from Wireless Access, and Motorola. Over 16 systems were deployed around the country for manufacturing tests, engineering protocol tests, antenna tests, and pager repair tests.

The project required technical skills in PC hardware design, C++, object-oriented programming, signal processing techniques, NT device driver development, Win32 user interface development, real-time, multi-threaded control, and proficiency with wireless communications lab equipment. Three patents have been issued based on technical inventions in this capacity.

Co-developed a wireless application protocol for sending and receiving encrypted email messages over the paging channel. Led the project team that deployed a software encryption module based on this protocol for government agencies.

8/2018 – Present **CUPP Cybersecurity, LLC • Palo Alto, California**

Position: *CEO*

Developing a suite of network security products and technologies aimed at consumers to protect their online internet access.

10/2012 – Present **BoughtStuff, Inc • Palo Alto, California**

Position: *Founder*

The company has developed a mobile application for storage and delivery of product information to smartphones over wireless networks.

Bims Laboratories, Inc Work History

6/2009 – 7/2009 **Eastman Kodak Company • Rochester, NY**

Position: *Technology Consultant*

Providing technology assessment on certain wireless communication patents.

10/2009 – 1/2017 **IEEE 802.16 Working Group**

Position: *Task Group Secretary, Task Group Vice-Chair, Task Group Chair, Working Group Vice-Chair & Secretary, IEEE 802.16 Expert*

Served in several leadership capacities within this group that is working on improvements to the IEEE 802.16 standard, otherwise known as WiMAX. The 802.16 Working Group entered hibernation on March 2018. From that time until the present, I am on the roster of Experts designated by the Chair to answer questions and provide clarification about the 802.16 standards.

2/2014 – Present **Access Network Protocol Development**

Position: *Technical Lead Developer*

Developing a C++17-based DES of SDRs for wired and wireless network protocols, that includes IMT-2020 channel models. Implementations of the IEEE 802 and LTE protocol families, plus PTP, PPoE, IPv6, digital cable, Bluetooth, DSL, frame relay and many other managed node models for smart grid and vertical IoT applications. Used for technical analysis of emerging wireless standards amendments.

Protocomm Systems, LLC Consulting History

04/1999–07/1999 **Gigabit Wireless, Inc. • San Jose, California**

Position: *Technical Leader*

Technical leader for the Wireless MAC design group. Responsible for comparative analysis of competing wireless MAC protocol standards. Responsible for the creation of a proprietary MAC protocol specification document, simulation of the protocol, and implementation in a prototype. Participated in early 802.16 protocol standards. This company was acquired by Intel Corporation.

3/2007 – 10/2009 **Apple, Inc. • Cupertino, CA**

Position: *Technology Consultant*

Participating in IEEE 802.16 standards meetings as an affiliate of the client.

7/2003 – Present **Various expert witness engagements (see below)**

Position: *Technical Expert Witness*

Testified as a wireless technology expert in patent infringement cases. For a list of such cases, see below.

Technical Expert Witness Experience

7/2022 – Present **Client: Russ, August & Kabat LLP (representing Vivato, Inc.)**

Case: XR Communications, LLC d/b/a Vivato Technologies, Civil Action No. 8:17-cv-00596-DOC(JDE)

Location: UNITED STATES DISTRICT COURT FOR THE CENTRAL DISTRICT OF CALIFORNIA – Hon. David O. Carter

Testifying expert in these matters involving smart antenna technology.

Expert Declaration:

August 23, 2022 Rebuttal Expert Report on Validity

Attorneys: For Plaintiff: Russ, August & Kabat LLP

For Defendant:

Status: Case ongoing

2/2022 – 12/2022 **Client: Fish & Richardson LLP (representing Apple, Inc.)**

Case: Litigation between Ericsson and Apple in Belgium, Brazil, Germany, Netherlands, and Colombia, and US matters:

Ericsson Inc. et. al. v. Apple Inc., Civil Action No. 6:22-cv-00061-ADA

Ericsson Inc., et. al, v. Apple Inc., Civil Action No. 2:21-cv-00376

Apple Inc. v. Telefonaktiebolaget LM Ericsson, et. al., Civil Action No. 2:21-cv-00460

In the Matter of Certain Mobile Phones Tablet Computers, Smart Watches, Smart Speakers, and Digital Media Players, and Products Containing Same.

U.S. Int’l Trade Commission Inv. No. 337-TA-3596

Location: UNITED STATES DISTRICT COURT FOR THE WESTERN DISTRICT OF TEXAS WACO DIVISION – Hon. Alan D. Albright

UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS

UNITED STATES INTERNATIONAL TRADE COMMISSION

Testifying expert in these matters involving 5G networking technology.

Expert Declaration:

May 18, 2022 COLOMBIA: Invalidity and Non-Infringement Technical Opinion regarding certain Colombia patents

April 27, 2022 COLOMBIA: Invalidity and Non-Infringement Technical Opinion regarding certain Colombia patents #1

April 27, 2022 COLOMBIA: Invalidity and Non-Infringement Technical Opinion regarding certain Colombia patents #2

March 28, 2022 COLOMBIA: Invalidity and Non-Infringement Technical Opinion regarding certain Colombia patents

March 9, 2022 BRAZIL: Invalidity Technical Opinion regarding Brazil patents

May 26, 2022 BRAZIL: Response to Ericsson Statement regarding Brazil patents

August 25, 2022 BRAZIL: Live testimony before the Brazil Patent and Trademark Office regarding invalidity

Attorneys: For Plaintiff:

For Defendant: Fish & Richardson, LLP

Status: Case settled

1/2022 – Present **Client: Finnegan LLP (representing Toyota Motor Corp., et. al.)**

Case: Intellectual Ventures I LLC, et. al. v. Toyota Motor Corp., et. al., Civil Action No. 2:21-cv-389

Toyota Motor Corp. (Petitioner) v. Intellectual Ventures II, LLC (Patent Owner)
Case No. IPR2022-01355

Location: UNITED STATES DISTRICT COURT FOR THE WESTERN DISTRICT OF TEXAS WACO DIVISION –

UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE PATENT TRIAL AND APPEAL BOARD

Testifying expert in this District Court and PTAB matter involving IEEE 802.11 wireless networking.

Expert Declaration:

August 25, 2022 PTAB Declaration ISO Petition for IPR

Attorneys: For Plaintiff:

For Defendant/Petitioner: Finnegan, LLP

Status: Case ongoing

1/2022 – Present **Client: Stroock LLP (representing TrackThings LLC)**

Case: TrackThings LLC v. NETGEAR, Inc.; TrackThings LLC v. NETGEAR, Inc.; TrackThings LLC v. Amazon.com, Inc. and Amazon.com Services LLC, and eero LLC., Civil Action No. 6:21-cv-00720

Location: UNITED STATES DISTRICT COURT FOR THE WESTERN DISTRICT OF TEXAS WACO DIVISION – Hon. Alan D. Albright

Testifying expert in this District Court matter involving wireless network reconfiguration.

Expert Declaration:

March 10, 2022 Declaration in support of claim construction responses

Attorneys: For Plaintiff:

For Defendant: Stroock, LLP

Status: Case ongoing

12/2021 – Present **Client: Axinn Veltrop & Harkrider LLP (representing Samsung Electronics Co., Ltd)**

Case: TOT Power Control, S.L. v. Samsung Elecs. Co., Ltd and Samsung Elecs. Am. Inc., Civil Action No. 1:21-cv-01305.

Location: UNITED STATES DISTRICT COURT FOR THE DISTRICT OF DELAWARE

Testifying expert in this District Court matter involving power control methods in wireless systems.

Attorneys: For Plaintiff:

For Defendant: Axinn, LLP

Status: Case ongoing

10/2021 – Present **Client: Wilkie Farr & Gallagher LLP (representing Lenovo and Motorola)**

Case: IPR Petitions relating to Bell Northern Research, LLC. v. Lenovo Group, Ltd., Lenovo (United States) Inc., and Motorola Mobility LLC, Civil Action No. 6:21-cv-00847

Location: UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE PATENT TRIAL AND APPEAL BOARD

Testifying expert in this IPR proceeding case involving training sequences in wireless networks.

Status: Case ongoing

10/2021 – 5/2022 **Client: Finnegan, Henderson, Farabow, Garrett & Dunner, LLP (representing MediaTek Inc.)**

Case: NXP USA, Inc. v. MediaTek Inc., et. al., Civil Action No. 2:21-cv-000318-JRG – Hon. Rodney Gilstrap

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS MARSHALL DIVISION

Testifying expert in this District Court matter involving 802.11n, 802.11ac, and 802.11ax chipsets.

Expert Report:

February 3, 2022 Declaration ISO Defendant's Claim Construction Brief

Attorneys: For Plaintiff: Duane Morris, LLP
For Defendant: Finnegan, LLP
Status: Case settled

09/2021 – Present **Client: Fish & Richardson, LLP (representing Samsung Electronics Co., Ltd., et. al.)**

Case: Smart Mobile Technologies, LLC v. Samsung Electronics Co., Ltd., et. al., Civil Action No. 6:21-cv-00701-ADA. Hon. Alan D. Albright

Location: UNITED STATES DISTRICT COURT FOR THE WESTERN DISTRICT OF TEXAS WACO DIVISION

Testifying expert in this District Court matter involving wireless voice and data transfer.

Expert Report:

June 8, 2022 Declaration ISO Defendant's Claim Construction Brief

Attorneys: For Plaintiff: Hagens Berman Sobol Shapiro, LLP
For Defendant: Fish & Richardson, LLP

Status: Case ongoing

05/2021 – Present **Client: Sidley Austin (representing HP Inc. and Microsoft Corporation)**

Case: SynKloud Technologies, LLC v. HP Inc., Civil Action No. 1:19-cv-01360-RGA and Microsoft Corporation v. SynKloud Technologies, LLC, Civil Action No. 1:20-cv-00007-RGA

Location: UNITED STATES DISTRICT COURT FOR THE DISTRICT OF DELAWARE

Testifying expert in this District Court matter involving wireless cloud storage.

Expert Report:

June 25, 2021 Declaration ISO Microsoft and HP's Claim Construction Brief

Expert Testimony:

Attorneys: For Plaintiff:
For Defendant: Sidley Austin

Status: Case ongoing

05/2021 – Present **Client: DLA Piper (representing Motorola Mobility LLC)**

Case: U.S. Int'l Trade Commission Inv. No. 337-TA-1253
Certain LTE-Compliant Cellular Communication Devices
Motorola v. Evolved Wireless LLC.

Location: UNITED STATES INTERNATIONAL TRADE COMMISSION –
Administrative Law Judge Cameron R. Elliot
Testifying expert in this ITC matter involving LTE cellular device handover.

Expert Report:

November 16, 2021 Expert Report on NonInfringement and Lack of Technical
Domestic Industry

Expert Testimony:

December 15, 2021 Deposition testimony

Attorneys: For Plaintiff: Nelson Bumgardner Albritton P.C.; Adduci, Mastriani &
Schaumberg, LLP

For Defendant: DLA Piper

Status: Case ongoing

04/2021 – 6/2022 **Client: Desmarais LLP (representing Google LLC and FitBit Inc.)**

Case: Cellspin Soft, Inc. v. Fitbit, Inc., No. 4-17-cv-05928-YGR

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF
CALIFORNIA

Hon. Yvonne Gonzalez Rogers

Testifying expert in this patent case involving the distribution of real-time health
data.

Expert Testimony:

October 29, 2021 Expert Report on NonInfringement

Attorneys: For Plaintiff: Garteiser Honea PLLC and Corcoran IP Law PLLC

For Defendant: Desmarais LLP

Status: Case settled. Summary Judgment for Non-Infringement.

03/2021 – Present **Client: Fish & Richardson LLP (representing Samsung Electronics Co., Ltd, and Samsung Electronics America, Inc.)**

Case: Ericsson Inc., and Telefonaktiebolaget LM Ericsson v. Samsung Electronics Co., Ltd., and Samsung Electronics America, Inc.

U.S. Int'l Trade Commission Inv. No. 337-TA-1248

Certain Cellular Communications Infrastructure Systems, Components Thereof, and Products Containing Same

Location: UNITED STATES INTERNATIONAL TRADE COMMISSION

Testifying expert in this ITC matter involving cellular networking.

Attorneys: For Plaintiff:

For Defendant: Fish & Richardson LLP

Status: Case ongoing

02/2021 – Present **Client: Fish & Richardson (representing Quectel)**

Client: Axinn, Veltrop & Harkrider LLP (representing Thales DIS AIS USA, LLC)

Client: Pearl Cohen LLP (representing Telit)

Case: U.S. Int'l Trade Commission Inv. No. 337-TA-1240

Certain UMTS and LTE Cellular Communication Modules and Products Containing the Same

Koninklijke Philips N.V. v Quectel Wireless Solutions Co. Ltd., Thales DIS AIS Deutschland GmbH, Thales S.A., Telit Wireless Solutions, Inc., Telit Communications PLC, CalAmp Corp, Xirgo Technologies, LLC, Laird Connectivity, Inc., Thales DIS AIS USA LLC

Case No. 1:20-cv-1713 (D. Del)

Location: UNITED STATES INTERNATIONAL TRADE COMMISSION –
Administrative Law Judge Hon. David P. Shaw

Testifying expert on 3GPP mobile device operation.

Expert Testimony:

July 21, 2021

Expert Report on Invalidity

August 6, 2021 Deposition Testimony
October 12, 2021 Live Testimony before ALJ David P. Shaw
Attorneys: For Plaintiff: Mayer Brown LLP
For Defendants: Fish & Richardson; Axinn, Veltrop & Harkrider LLP
Status: Case closed

11/2020– Present **Client: Orrick, Herrington & Sutcliffe LLP (representing PayPal Holdings, Inc.)**

Case: IOENGINE LLC v PayPal Holdings, Inc.
Civil Action No. 1:18-cv-00452-WCB

Location: UNITED STATES DISTRICT COURT FOR THE DISTRICT OF DELAWARE
Hon. William C. Bryson

Testifying expert in this patent case involving peripheral device communication to remote servers.

Expert Testimony:

November 19, 2021 Expert Report on Invalidity

January 7, 2022 Expert Report on Non-Infringement

January 20-21, 2022 Deposition Testimony on Invalidity and Non-Infringement

Status: Case ongoing

11/2020 – Present **Client: Holland & Knight (representing Apple, Inc.)**

Case: Maxell v. Apple Inc. In the Matter of Certain Mobile Electronic Devices and Laptop Computers

U.S. Int'l Trade Commission Inv. No. 337-TA-1215

Location: UNITED STATES INTERNATIONAL TRADE COMMISSION –
Administrative Law Judge Hon. Dee Lord

Testifying expert on 3GPP mobile device operation.

Expert Testimony:

February 24, 2020: Opening Expert Report Regarding Invalidity

Attorneys: For Plaintiff: Mayer Brown LLP

For Defendant: DLA Piper LLP

Status: Case ongoing

9/2020– 9/2021 **Client: DickinsonWright (representing Nippon Telegraph & Telephone Co. and Essential WiFi, LLC)**

Case: NTT Corp., et. al. v. MediaTek, Acer, and Texas Instruments

Civil Action No. 1:20-cv-00632-ADA. Hon. Alan D. Albright

Location: UNITED STATES DISTRICT COURT FOR THE WESTERN DISTRICT OF TEXAS AUSTIN DIVISION – Hon. Alan Albright

Testifying expert in this patent case involving MIMO technology.

Expert Testimony:

Status: Case closed

8/2020– Present **Client: Folio Law Group PLLC (representing Dali Wireless)**

Case: Dali Wireless, Inc. v. Corning Optical Communications, LLC,

Civil Action No. 3:20-cv-06469-EMC

Location: UNITED STATES DISTRICT COURT FOR THE WESTERN DISTRICT OF TEXAS – Hon. Edward M. Chen

Testifying expert in this patent case involving distributed antenna system networks.

Expert Testimony:

November 6, 2020: Declaration Regarding Interpretation of Asserted Claims

February 12, 2021: Declaration Regarding Interpretation of Asserted Claims

August 22, 2022: Deposition Testimony

Status: Case ongoing

3/2020– Present **Client: Folio Law Group PLLC (representing Dali Wireless)**

Case: Dali Wireless, Inc. v. CommScope Technologies, LLC and CommScope Holding Company, Inc..

Civil Action No. 1:19-cv-00952-MN

Location: UNITED STATES DISTRICT COURT FOR THE DISTRICT OF DELAWARE – Hon. Maryellen Noreika

Testifying expert in this patent case involving distributed antenna system networks.

Expert Testimony:

June 23, 2021: Expert report on infringement.

August 16, 2021: Reply Expert report on infringement of '338 Patent

Status: Case ongoing

03/2020 – Present **Client: Sidley Austin LLP (representing Lenovo and Motorola)**

Case: InterDigital Technology Corporation, IPR Licensing, Inc., InterDigital Communications, Inc., InterDigital Holdings, Inc., and InterDigital, Inc. v. Lenovo Holding Company, Inc., Lenovo (United States) Inc., and Motorola Mobility LLC

Civil Action No. 19-1590-LPS

Location: UNITED STATES DISTRICT COURT FOR THE DISTRICT OF DELAWARE

Hon. Leonard P. Stark

Testifying expert in this patent case involving 3G and 4G cellular standards.

Expert Testimony:

June 16, 2022: Expert Report on Invalidity of 8,675,612 and 9,456,449 patents

June 16, 2022: Expert Report on Invalidity of 8,085,665 and 8,427,954 patents

August 8, 2022: Rebuttal Expert Report on Invalidity

Status: Case ongoing

3/2020– Present **Client: Finnegan, Henderson, Farabow, Garrett & Dunner LLC (representing Google)**

Case: Google, Inc. (Petitioner) v. Sonos, Inc.

Location: UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE PATENT TRIAL AND APPEAL BOARD

Testifying expert in this IPR proceeding involving wireless home speaker systems.

Expert Testimony:

February 22, 2021: Filed declarations in support of Inter Partes Review.

Status: Case ongoing

08/2019 – Present **Client: Fish & Richardson (representing Finjan, Inc.)**

Case: Finjan, Inc. v. Cisco, Inc.

Civil Action No. 5:17-cv-00072-BLF-SVK

Location: UNITED STATES DISTRICT COURT FOR THE SOUTHERN DISTRICT OF CALIFORNIA SAN DIEGO DIVISION – Hon. Susan Van Keulen

As a testifying expert, provided a technology tutorial in this patent case involving internet security technology.

Expert Testimony:

August 14, 2019 Tutorial expert report on network security technology.

September 4, 2019 Deposition Testimony

Attorneys: For Plaintiff: Fish & Richardson

For Defendant:

Status: Case ongoing

8/2019 – 5/2020 **Client: Fish & Richardson (representing LG Electronics, Inc.)**

Case: Bell Northern Research, LLC v. LG Electronics, Inc., et. al.

USDC-SDCA Civil Action No. 18-cv-2864-CAB-BLM

Location: UNITED STATES DISTRICT COURT FOR THE SOUTHERN DISTRICT OF CALIFORNIA – Hon. Cathy Ann Bencivengo, Magistrate Judge: Hon. Barbara L. Major

Testifying expert on wired/wireless communication in gaming systems.

Expert Testimony:

November 20, 2019 Declaration ISO motion for summary judgment

Attorneys: For Plaintiff: Skiermont Derby LLP

For Defendant: Fish & Richardson

Status: Case closed

7/2019 – 05/2021 **Client: O'Melveny & Myers LLP (representing Apple Inc.)**

Case: Maxell, Ltd. v. Apple Inc.,

Case No. 5:19-cv-00036-RWS.

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS TEXARKANA DIVISION – Hon. Robert W. Schroeder III

Testifying expert on 3G cellular telephone technology.

Expert Testimony:

May 7, 2020: Opening Expert Report Regarding Invalidity

June 4, 2020: Rebuttal Expert Report on Non-Infringement

Deposition Testimony: June 24, 2020

Attorneys: For Plaintiff: Mayer Brown LLP

For Defendant: O'Melveny & Myers LLP

Status: Case settled.

4/2019 – Present **Client: Perkins Coie (representing Nintendo of America, Inc.)**

Case: Genuine Enabling Technology LLC v. Nintendo Company Ltd., and Nintendo of America, Inc., W.D. Wash.,

Civil Action No. 2:19-cv-00351-RSM

Location: UNITED STATES DISTRICT COURT FOR THE WESTERN DISTRICT OF WASHINGTON – Hon. Ricardo S. Martinez

Testifying expert on wired/wireless communication in gaming systems.

Expert Declarations:

October 23, 2019 Declaration ISO claim constructions

November 26, 2019 Sur-reply declaration ISO claim constructions

January 23, 2020 Declaration ISO motion for summary judgment

April 20, 2020 Opening Expert Report Regarding Invalidity

Expert Depositions:

December 19, 2019

Claim Construction Hearing Testimony:

February 24, 2020 Tutorial testimony on the technology of the Asserted Patents

Attorneys: For Plaintiff: Bayard, P.A.

For Defendant: Perkins Coie

Status: Case closed

12/2019 – 12/2019 **Client: Erise IP (representing Apple Inc.), Haynes and Boone, LLP (representing Ericsson Inc)**

Case: Ericsson Inc. (Petitioner) v. Uniloc 2017, LLC (Patent Owner)

Apple Inc. (Petitioner) v. Uniloc 2017, LLC (Patent Owner) Case No. IPR2020-00224

Location: UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE PATENT TRIAL AND APPEAL BOARD

Testifying expert in this IPR proceeding involving ARQ data exchange on LTE networks.

Expert Declarations:

December 16, 2019 Declaration ISO Petition for Inter Partes Review of U. S. Patent No. 7,075,917

Attorneys: For Petitioner: Erise IP; Haynes and Boone, LLP

For Patent Owner:

Status: Case closed

6/2019 – Present **Client: Fish & Richardson (representing Microsoft Corporation)**

Case: Microsoft Corp. (Petitioner) v. Uniloc 2017, LLC (Patent Owner)

Uniloc 2017, LLC v. Microsoft Corp.

USDC Central District of California, Case Nos. 8:18-cv-2053, 8:18-cv-2054, 8:18-cv-2224; 8:19-cv-0428, 8:19-cv-0477, 8:19-cv-0196

Location: UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE PATENT TRIAL AND APPEAL BOARD

Testifying expert in this IPR proceeding involving 3GPP transport formats and channels.

Expert Declarations:

August 6, 2019 Declaration in support of claim construction

Attorneys: For Plaintiff: Feinberg Day LLP

For Defendant: Fish & Richardson

Status: Case ongoing

2/2019 – 5/2020 **Client: Klarquist Sparkman, LLP (representing Microsoft Corporation)**

Case: Uniloc 2017, LLC v. Microsoft Corp.

Location: UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE PATENT TRIAL AND APPEAL BOARD

Testifying expert in this IPR proceeding involving ARQ data exchange on LTE networks.

Expert Declarations:

April 14, 2019 Declaration ISO Petition for Inter Partes Review of U. S. Patent No. 7,075,917

Attorneys: For Plaintiff:

For Defendant: Klarquist LLP

Status: Case ongoing

10/2018 – Present **Client: Kramer Levin Naftalis & Frankel, LLP (representing Finjan, Inc.)**

Case: Finjan, Inc. v. Eset, Inc.

Civil Action No. 3:17-cv-00183-CAB-BGS

Location: UNITED STATES DISTRICT COURT FOR THE SOUTHERN DISTRICT OF CALIFORNIA SAN DIEGO DIVISION – Hon. Cathy Ann Bencivengo

As a testifying expert, provided a technology tutorial in this patent case involving internet security technology.

Expert Declaration:

October 5, 2018 Tutorial expert report on network security technology.

March 11, 2020 Jury trial testimony.

Attorneys: For Plaintiff: Kramer Levin, Naftalis, & Frankel LLP

For Defendant:

Status: Jury Trial Mistrial due to COVID-19.

Case ongoing

9/2018 – Present **Client: Kramer Levin Naftalis & Frankel, LLP (representing Finjan, Inc.)**

Case: Finjan, Inc. v. Juniper, Inc.

Civil Action No. 15-cv-03295-BLF-SVK

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF CALIFORNIA SAN JOSE DIVISION – Hon. Beth L. Freeman

As a testifying expert, provided a technology tutorial in this patent case involving internet security technology.

Expert Declaration:

September, 11, 2018 Tutorial expert report on network security technology.

Videotaped Deposition:

November 7, 2018

Attorneys: For Plaintiff: Kramer Levin, Naftalis, & Frankel LLP

For Defendant:

Status: Case closed

9/2017 – 9/2018 **Client: (Covington & Burling representing Huawei Device USA, Inc.)**

Case: Optis Wireless Technology, LLC, et. al. v. Huawei Technologies Co. Ltd, et. al.
Civil Action No. 2:17-cv-123-JRG-RSP

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF
TEXAS MARSHALL DIVISION – Hon. Roy S. Payne

Testifying expert regarding 3G and LTE technology.

Expert Declarations and Reports:

November 3, 2017: Declaration regarding Claim Construction.

March 26, 2018: Initial Expert Report Regarding Invalidity

April 23, 2018: Rebuttal Expert Report on Non-Infringement

April 27, 2018: Rebuttal Expert Report on Secondary Considerations

Videotaped Deposition: May 10, 2018

May 14, 2018: Declaration in support of Motion for Partial Summary
Judgment

Jury Trial Testimony: August 22, 2018 and August 23, 2018

Attorneys: For Plaintiff: McKool Smith

For Defendant: Covington & Burling

Status: Jury award

6/2017 – 4/2018 **Client: Kramer Levin Naftalis & Frankel, LLP (representing Finjan, Inc.)**

Case: Finjan, Inc. v. Symantec, Inc.

Civil Action No. 4:14-cv-02998-HSG

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF

CALIFORNIA OAKLAND DIVISION

As a testifying expert, provided a technology tutorial in this patent case involving internet security technology.

Expert Declaration:

July 27, 2017 Tutorial expert report on security technology.

Videotaped Deposition:

August 29, 2017

Attorneys: For Plaintiff: Kramer Levin, Naftalis, & Frankel LLP

For Defendant: Quinn Emmanuel

Status: Case settled

5/2017 – 3/2018 **Client: Barnes & Thornburg, LLP (representing Ooma, Inc.)**

Case: Ooma, Inc. (Petitioner) v. Deep Green Wireless, LLC (Patent Owner)

Location: UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE
PATENT TRIAL AND APPEAL BOARD

As a testifying expert, provided a technology tutorial in this patent case involving voice and data communications over wireless networks.

Expert Declaration:

June 8, 2017 Expert report on prior art wireless network technology.

Videotaped Deposition:

February 15, 2018

Attorneys: For Petitioner: Barnes & Thornburg LLP

For Defendant: Mischcon De Reya New York, LLP

Status: Case closed

3/2017 – 6/2019 **Client: Fish & Richardson (representing Apple, Inc.) / Gibson, Dunn & Crutcher LLP (representing Compal Electronics, et. al.)**

Case: Apple Inc. v. Qualcomm Inc.

Qualcomm Inc. v. Compal Electronics, Inc., et. al.

Civil Action No. 3:17-cv-00108 / Civil Action No. 3:17-cv-01010

Location: UNITED STATES DISTRICT COURT FOR THE SOUTHERN DISTRICT OF
CALIFORNIA – Hon. Gonzalo P. Curiel, Magistrate Judge: Hon. Mitchell D.
Dembin

Testifying expert regarding LTE technology.

Expert Declaration:

December 11, 2017: Declaration regarding Claim Construction.

Expert Report:

June 29, 2018: Opening Expert Report regarding invalidity

August 3, 2018: Expert Report on infringement

October 2, 2018: Rebuttal Expert Report on Invalidity

Videotaped Deposition:

October 25, 2018

None

Attorneys: For Apple: Fish & Richardson

For Qualcomm: Quinn Emanuel Urquhart & Sullivan LLP / Cravath, Swaine & Moore LLP

For Compal Electronics, Inc., et. al: Gibson, Dunn & Crutcher LLP

Status: Case settled.

3/2017 – 1/2018 **Client: Kramer Levin Naftalis & Frankel, LLP (representing Finjan, Inc.)**

Case: Finjan, Inc. v. Blue Coat Systems, LLC

Civil Action No. 15-cv-03295-BLF-SVK

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF CALIFORNIA SAN JOSE DIVISION – Hon. Beth L. Freeman

As a testifying expert, provided an opening technology tutorial at trial in this patent case involving internet security technology.

Expert Declaration:

March 29, 2017 Tutorial expert report on security technology.

Videotaped Deposition:

May 2, 2017

October 31 – November 2, 2017: Jury Trial Testimony

January 8-10, 2018: Jury Trial Testimony (retrial after mistrial):

Live Testimony on Network Security Technology Tutorial

Attorneys: For Plaintiff: Kramer Levin, Naftalis, & Frankel LLP

For Defendant: Morrison & Forrester & Quinn Emmanuel

Status: Jury award

1/2017 – 7/2017 **Client: Foster Pepper LLP (representing Dali Wireless)**

Case: Dali Wireless, Inc. (Petitioner) v. CommScope Technologies, LLC (Patent Owner)

Location: UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE PATENT TRIAL AND APPEAL BOARD

Testifying expert in this patent case involving RF transport networks.

Expert Reports:

4-26-17 Declaration ISO petition for IPR

6-30-17 Declaration ISO Opening claim construction brief

Videotaped Deposition:

July 24, 2017

Status: Case closed

1/2017 – 6/2019 **Client: Dorsey & Whitney LLP (representing Dali Wireless)**

Case: CommScope Technologies, LLC (Plaintiff/Counterclaim Defendant) v. Dali Wireless, Inc. (Defendant/Counterclaim Plaintiff)

Civil Action No.: 3:16-cv-477

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF TEXAS DALLAS DIVISION – Hon. Barbara M. G. Lynn

Testifying expert in this patent case involving RF transport networks.

Expert Reports:

8-24-18 Expert Report regarding Invalidity of CommScope patents

8-24-18 Expert Report regarding Infringement of Dali Wireless patents

11-5-18 Expert Report regarding Validity of Dali Wireless patents

11-5-18 Expert Report regarding Non-Infringement of CommScope patents

1-9-19 Declaration ISO opposition to MSJ

1-18-19 Declaration ISO partial MSJ on Non-infringement and Invalidity

5-2-19 Declaration ISO Motion for Sanctions

Videotaped Deposition:

November 20, 2018

Live Testimony at Jury Trial:

June 10-13, 2019

Attorneys: For Plaintiff: Dorsey & Whitney, LLC

For Defendant: Carlson Caspers, P.A.

Status: Jury award.

11/2016 – 4/2019 **Client: Boies, Schiller & Flexner LLP (representing Apple Inc.)**

Case: Evolved Wireless, LLC v. Apple, Inc.

Civil Action No.: 1:15-cv-00542-SLR

Location: UNITED STATES DISTRICT COURT FOR THE DISTRICT OF DELAWARE
– Hon. Sue L. Robinson

Testifying expert in this patent case involving LTE wireless networks.

Expert Reports:

11-06-17 Declaration ISO Summary Judgment of Validity

10-05-17 Declaration ISO Summary Judgment of Non-Infringement

10-03-17 Supplemental Expert Report on Non-Infringement

07-24-17 Supplemental Expert Report on Secondary Considerations of Non-Obviousness

6-26-17 Expert Report on Non-Infringement

5-22-17 Expert Report on Invalidity

Videotaped Deposition:

August 11, 2017

Live Testimony at Jury Trial:

March 29 - April 1, 2019

Attorneys: For Plaintiff: Boies, Schiller & Flexner LLP

For Defendant: Robins Kaplan LLP

Status: Jury verdict of non-infringement.

7/2016 – 4/2018 **Client: Jackson Walker LLP (representing D&M Holdings, Inc., et. al.)**

Case: Sonos, Inc., v. D&M Holdings, d/b/a The D+M Group, D&M Holdings U.S. Inc.,

and Denon Electronics (USA), LLC

Civil Action No.: 16-0141-RGA

D&M Holdings Inc., d/b/a The D+M Group, D&M Holdings U.S. Inc. v. Sonos, Inc.

Location: UNITED STATES DISTRICT COURT FOR THE DISTRICT OF DELAWARE
– Hon. Richard G. Andrews

Testifying expert in this patent case involving wireless speaker networks.

Expert Testimony:

9-11-17 Expert Report on Infringement

6-29-22 Remote Videotaped Deposition

Attorneys: For Plaintiff: Jackson Walker LLP

For Defendant: Potter Anderson & Corroon LLP

Status: Case settled

7/2016 – 1/2018 **Client: Kramer Levin Naftalis & Frankel, LLP (representing Finjan, Inc.)**

Case: Palo Alto Networks, Inc. (Petitioner) v. Finjan, Inc. (Patent Owner)

Case IPR2015-02001, Case IPR2016-00157. US Patent No. 8,225,408 B2

Case IPR2015-01974

Location: UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE
PATENT TRIAL AND APPEAL BOARD

Testifying expert in this patent case involving wireless speaker networks.

Expert Declaration:

8-9-16 Expert Declaration, Patent 7,647,633

8-9-16 Expert Declaration, Patent 8,225,408

8-30-16 Supplemental Expert Declaration, 7,647,633

Status: Case settled

5/2016 – 7/2018 **Client: (Winston & Strawn LLP representing Atlantic Broadband Group, LLC, et. al.)**

Case: ChanBond LLC v. Atlantic Broadband Group, LLC, et. al.

Civil Action No: 15-842-RGA, 15-843-RGA, 15-844-RGA, , 15-845-RGA, , 15-846-RGA, , 15-847-RGA, , 15-848-RGA, , 15-849-RGA, , 15-850-RGA, , 15-851-RGA, , 15-852-RGA, , 15-853-RGA, , 15-854-RGA

Location: UNITED STATES DISTRICT COURT FOR THE DISTRICT OF DELAWARE
– Hon. Richard G. Andrews

Testifying expert regarding digital cable technology.

Expert Report:

10-24-17 Expert Report on Invalidity

Videotaped Deposition:

None

Attorneys: For Plaintiff: Bayard, P.A.

For Defendant: Winston & Strawn LLP

Status: Case settled

5/2016 – 11/2019 **Client: (Torys LLP representing Telus, Bell, and Rogers)**

Case: Wi-LAN Inc. v Telus Communications Company, Rogers Communications
Canada Inc., and Bell Mobility Inc.

Court File No. T-301-16; Court File No. T-303-16; Court File No. T-304-16

Location: CANADIAN FEDERAL COURT – Hon. Mandy Ayles

Testifying expert regarding LTE technology.

Expert Report:

June 14, 2019 Expert Report regarding invalidity

Videotaped Deposition:

None

Attorneys: For Plaintiff: Torys LLP

For Defendant:

Status: Case settled

12/2015 – 4/2016 **Client: Kramer Levin Naftalis & Frankel, LLP (representing Acceleration
Bay, LLC.)**

Case: Activision Blizzard, Inc., Electronic Arts Inc., Take-Two Interactive Software,
Inc., 2K Sports, Inc., Rockstar Games, Inc., and Bungie, Inc., Petitioner v.
Acceleration Bay, LLC, Patent Owner.

Case IPR2015-01951, Case IPR2015-01953, Case IPR2015-01964, Case
IPR2015-01970, Case IPR2015-01996, Case IPR2016-00724, Case IPR2016-
00747

Location: UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE
PATENT TRIAL AND APPEAL BOARD

Testifying expert in this IPR patent case involving internet data broadcasting.

Expert Declaration:

January 4, 2017 Supplemental Declaration ISO Patent Owner's Response -- Case
IPR2016-00724

January 4, 2017 Supplemental Declaration ISO Patent Owner's Response -- Case
IPR2016-00747

December 7, 2016 Declaration ISO Patent Owner's Response – Case IPR2016-
00724; Secondary Considerations of Non-Obviousness

December 7, 2016 Declaration ISO Patent Owner's Response – Case IPR2016-
00747; Secondary Considerations of Non-Obviousness

July 17, 2016 Declaration ISO Patent Owner's Response – Patent 6,714,966;
Secondary Considerations of Non-Obviousness

July 17, 2016 Declaration ISO Patent Owner's Response – Patent 6,829,634;
Secondary Considerations of Non-Obviousness

July 17, 2016 Declaration ISO Patent Owner's Response – Patent 6,701,344;
Secondary Considerations of Non-Obviousness

Videotaped Deposition:

February 7, 2017 and February 8, 2017

Attorneys: For Plaintiff: Kramer Levin, Naftalis, & Frankel LLP

For Defendant: DLA Piper

Status: Case closed

4/2016 – Present **Client: Kramer Levin Naftalis & Frankel, LLP (representing Acceleration
Bay, LLC.)**

Case: Acceleration Bay, LLC v Activision Blizzard, Inc., Electronic Arts Inc., Take-
Two Interactive Software, Inc.

Civil Action No.: 14-453 (RGA), 16-454 (RGA), 16-455 (RGA)

Location: UNITED STATES DISTRICT COURT FOR THE DISTRICT OF DELAWARE
– Hon. Richard G. Andrews

Testifying expert in this IPR patent case involving internet data broadcasting.

Expert Declaration:

September 24, 2017: Expert Report Regarding Technology Benefits of the

Asserted Patents

Videotaped Deposition: January 4, 2018

July 17, 2018: Reply Report Regarding Technology Benefits of the Asserted Patents

Attorneys: For Plaintiff: Kramer Levin, Naftalis, & Frankel LLP

For Defendant: DLA Piper

Status: Ongoing

12/2015 – 9/2016 **Client: Kramer Levin Naftalis & Frankel, LLP (representing Finjan, Inc.)**

Case: Finjan, Inc. v. Sophos, Inc.

Civil Action No. 3:14-cv-01197-WHO

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF CALIFORNIA SAN FRANCISCO DIVISION – Hon. William H. Orrick

As a testifying expert, provided a technology tutorial in this patent case involving internet security technology.

Expert Declaration:

December 21, 2015 Tutorial expert report on network security technology.

Videotaped Deposition:

February 22, 2016

September 5 – 9, 2016 Jury Trial:

Live Testimony at Jury Trial regarding tutorial on network security

Attorneys: For Plaintiff: Kramer Levin, Naftalis, & Frankel LLP

For Defendant: DLA Piper

Status: Jury Trial

9/2015 – 2/2016 **Client: Brinks Gilson & Lione (representing LifeWatch Services, Inc., and Card Guard Scientific Survival, Ltd.)**

Case: Card Guard Scientific Survival Ltd.

Reexam Control No. 12/706,541

Location: UNITED STATES PATENT AND TRADEMARK OFFICE

Provided testimony in this Patent Office re-examination appeal.

Expert Declaration:

November 13, 2015 Declaration under 37 C.F.R §1.132.

February 13, 2016 Declaration ISO petition for IPR.

Attorneys: For Plaintiff: Brinks Gilson & Lione

Status: Re-examination appeal decision invalidated the patent.

9/2015 – 1/2017 **Client: Kramer Levin Naftalis & Frankel, LLP (representing Finjan, Inc.)**

Case: Finjan, Inc. v. Proofpoint, Inc. and Armorize Technologies, Inc.

Civil Action No. 13:cv-03999-BLF

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF CALIFORNIA SAN JOSE DIVISION – Hon. Howard R. Lloyd, Hon. Haywood S. Gilliam, Jr.

As a testifying expert, provided an opening technology tutorial report in this patent case involving internet security technology.

Expert Declaration:

October 7, 2015 Tutorial expert report on network security technology.

Videotaped Deposition:

November 6, 2015

Attorneys: For Plaintiff: Kramer Levin, Naftalis, & Frankel LLP

For Defendant: Quinn Emanuel

Status: Case settled

8/2015 – 12/2015 **Client: Brinks Gilson LLP (representing ZTE Corporation and ZTE (USA), Inc.)**

Case: Inter-System Handover of a Mobile Terminal Operable with a First and a Second Radio Access Network

ZTE v. Vringo Infrastructure, Inc.

Location: UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE PATENT TRIAL AND APPEAL BOARD

Testifying expert in this IPR proceeding involving 3GPP cellular technology.

Expert Declarations:

08-28-15 Declaration ISO Petition for Inter Partes Review of U. S. Patent No. 7,126,940

09-04-15 Declaration ISO Petition for Inter Partes Review of U. S. Patent No. 7,242,943

09-04-15 Declaration ISO Petition for Inter Partes Review of U. S. Patent No. 7,558,283

09-04-15 Declaration ISO Petition for Inter Partes Review of U. S. Patent No. 8,812,000

09-04-15 Declaration ISO Petition for Inter Partes Review of U. S. Patent No. 7,724,720

10-12-15 Declaration ISO Petition for Inter Partes Review of U. S. Patent No. 7,242,933

Videotaped Deposition:

None

Attorneys: For Plaintiff:

For Defendant: Brinks Gilson, LLP

Status: Case settled.

11/2014 – Present **Client: Fish & Richardson (representing Regents of the University of Minnesota)**

Case: Regents of the University of Minnesota v. AT&T Mobility, LLC, Sprint Solutions, Inc., T-Mobile USA, Inc., Cellco Partnership d/b/a Verizon Wireless
Civil Action No. 14-cv-4666

Location: UNITED STATES DISTRICT COURT FOR THE DISTRICT OF MINNESOTA
– Hon. Tony N. Leung

Testifying expert on 3GPP error correction coding, precoding, and modulation.

Expert Report:

None.

Attorneys: For Plaintiff: Fish & Richardson

For Defendant:

Status: Case ongoing

10/2014 – 2/2015 **Client: Alston & Bird (representing Microsoft Corporation)**

Case: Microsoft Corporation. v. IPR Licensing, Inc.

Location: UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE
PATENT TRIAL AND APPEAL BOARD

Testifying expert in this IPR proceeding involving cellular technology.

Expert Declarations:

10-16-14 Supplemental Declaration ISO Petition for Inter Partes Review of U.
S. Patent No. 8,380,244

Attorneys: For Plaintiff: Alston & Bird LLP

For Defendant:

Status: Case settled

9/2014 – 4/2015 **Client: Reed & Scardino, LLP (representing Mobile Telecommunications Technologies, LLC)**

Case: Mobile Telecommunications Technologies LLC v. Amazon.com, Inc.

Civil Action No. 2:13-CV-883-JRG-RSP

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF
TEXAS MARSHALL DIVISION – Hon. Roy S. Payne

Testifying expert in this patent case involving package delivery notification
systems.

Expert Reports:

4-06-15 Second Supplemental Expert Report on Infringement

2-10-15 Expert Report on Infringement

2-24-15 Supplemental Expert Report on Infringement

Videotaped Deposition:

2-25-15

Declaration:

3-20-15 Declaration ISO Response to Opposition Motion

Attorneys: For Plaintiff: Reed & Scardino LLP

For Defendant: Greenberg Traurig LLP

Status: Case settled

5/2014 – 7/2015 **Client: Kramer Levin Naftalis & Frankel, LLP (representing Finjan, Inc.)**

Case: Finjan, Inc. v. Blue Coat Systems, Inc.

Civil Action No. 3:13-cv-03999-BLF

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF CALIFORNIA SAN JOSE DIVISION – Hon. Beth L. Freeman

As a testifying expert, provided an opening technology tutorial at trial in this patent case involving internet security technology.

Expert Declaration:

January 12, 2015 Tutorial expert report on security technology.

Videotaped Deposition:

March 18, 2015

Live Jury Trial Testimony: July 20, 2015.

Live Bench Trial on Laches Testimony: September 8, 2015

Attorneys: For Plaintiff: Kramer Levin, Naftalis, & Frankel LLP

For Defendant: Wilson Sonsini

Status: Jury award.

4/2014 – 12/2014 **Client: Reed & Scardino, LLP (representing Mobile Telecommunications Technologies, LLC)**

Case: Mobile Telecommunications Technologies LLC v. United Parcel Service, Inc.

Civil Action No. 1:12-cv-03222-AT

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF GEORGIA ATLANTA DIVISION – Hon. Amy Totenberg

Testifying expert in this patent case involving package delivery notification systems.

Expert Reports:

7-3-14 Opening Expert Report regarding Infringement

8-11-14 Rebuttal Expert Report regarding Infringement

Videotaped Depositions:

10-7-14

Declaration:

11-24-14 Declaration ISO Response to MSJ

Attorneys: For Plaintiff: Reed & Scardino LLP

For Defendant: Alston & Bird LLP

Status: Case settled.

12/2013 – 9/2015 **Client: Brinks Gilson & Lione LLP (representing ZTE Corp, and ZTE (USA), Inc.)**

Case: ZTE Corporation and ZTE (USA) Inc. v. InterDigital Technology Corporation

Location: UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE
PATENT TRIAL AND APPEAL BOARD

Testifying expert in this IPR proceeding involving cellular technology.

Expert Declarations:

3-21-14 Declaration in support of the Petition for Inter Partes Review of U. S.
Patent No. 8,380,244

Attorneys: For Plaintiff: Brinks Gilson & Lione

For Defendant: Latham & Watkins, LLP

Status: IPR Hearing before PTAB: All disputed claims are unpatentable.

12/2013 – 4/2014 **Client: Kramer Levin Naftalis & Frankel LLP (representing Sirius XM Radio Inc.)**

Case: Catch a Wave Technologies, Inc. v. Sirius XM Radio Inc.

Case No. 3:12-cv-05791-WHA

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF
CALIFORNIA SAN FRANCISCO DIVISION – Hon. William Alsup

Testifying expert in this patent case involving satellite radio systems.

Expert Reports:

2-14-2014 Expert Report regarding non-infringement

Attorneys: For Plaintiff: Freitas Tseng & Kaufman LLP

For Defendant: Kramer Levin LLP

Status: Case settled

2/2013 – 7/2016 **Client: Reed & Scardino, LLP (representing Mobile Telecommunications Technologies, LLC)**

Case: Mobile Telecommunications Technologies LLC v. BlackBerry Corporation.
Civil Action No. 3:12-cv-1652-M

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF TEXAS DALLAS DIVISION – Hon. Barbara M. G. Lynn

Testifying expert in this patent case involving package delivery notification systems.

Expert Reports:

9-3-15 Expert Report on Infringement

Videotaped Depositions:

November 18, 2015

Live Testimony at Jury Trial: July 13, 2016.

Attorneys: For Plaintiff: Baker Botts, LLP

For Defendant: Reed & Scardino LLP

Status: Jury verdict of non-infringement.

9/2013 – 1/2014 **Client: Reed & Scardino, LLP (representing Mobile Telecommunications Technologies, LLC)**

Case: Mobile Telecommunications Technologies, LLC v Clearwire Corporation
Civil Action No. 2:12-CV-308

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS MARSHALL DIVISION – Hon. Roy S. Payne

Testifying expert in this patent case involving wireless networking signals.

Expert Reports:

11-11-13 Rebuttal report regarding validity

Videotaped Depositions:

12-5-13

Declarations:

1-23-14 Declaration before the Patent Trial and Appeal Board in Case IPR2013-00306

Attorneys: For Plaintiff: Reed & Scardino LLP
For Defendant: Shook, Hardy & Bacon, LLP
Status: Case settled

10/2013 – 5/2015 **Client: Foley & Lardner, LLP (representing Motorola Mobility, LLC)**
Case: University of Florida Research Foundation Inc., and Rapid Mobile Technologies, Inc. v Motorola Mobility, LLC.
Case No. 13-cv-61120-KMM-EGT
Location: UNITED STATES DISTRICT COURT FOR THE SOUTHERN DISTRICT OF FLORIDA FORT LAUDERDALE DIVISION – Hon. K. Michael Moore, Magistrate Judge: Hon. Edwin G. Torres
Testifying expert in this patent case involving mobile device testing systems.
Expert Reports:
None.
Declarations:
11-21-13 Declaration ISO Motorola’s Responsive Claim Construction Brief
Attorneys: For Plaintiff: Meltzer & Meksraitis
For Defendant: Foley & Lardner LLP
Status: Case settled

7/2013 – 6/2015 **Client: WilmerHale (representing Broadcom)**
Case: Inter Partes Review of US Patent 6,424,625; 6,772,215; and 6,466,568 owned by Ericsson
Docket No. 0111168-0240
Location: UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE PATENT TRIAL AND APPEAL BOARD
Testifying expert in this Inter Partes Review regarding ARQ mechanisms.
Expert Declarations:
9-19-13 Declaration regarding US Patent 6,772,215
9-19-13 Declaration regarding US Patent 6,466,568
9-29-13 Declaration regarding US Patent 6,424,625

Videotaped Deposition:

5-29-14, and 5-30-14

Attorneys: For Plaintiff: Meltzer & Mathis

For Defendant: Wilmer Cutler Pickering Hale and Dorr LLP

Status: IPR Petition granted. All claims invalidated

4/2013 – 4/2015 **Client: Kilpatrick Townsend & Stockton LLP (representing Google Inc. and Motorola Mobility LLC)**

Case: Fujifilm Corporation v. Motorola Mobility LLC

Case No. 3:12-cv-03587 WHO

Location: UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF CALIFORNIA SAN FRANCISCO DIVISION – Hon. Richard Seeborg

Testifying expert in this patent case involving smartphone technology.

Expert Declarations:

4-23-14 Declaration ISO Motion for Protective Order

12-9-14 Declaration ISO MSJ

Expert Reports:

10-3-14 Opening Expert Report Regarding Invalidity

10-31-14 Rebuttal Expert Report on non-infringement

10-31-14 Appendix A to Rebuttal Report of Dr. Alan Bovik

Videotaped Deposition:

11-19-14, and 11-20-14

Trial Testimony:

April 28, 2015 Non-infringement and invalidity of '970 Patent

Attorneys: For Plaintiff: Morgan, Lewis & Bockius LLP

For Defendant: Kilpatrick Townsend & Stockton LLP

Status: Jury verdict: '970 Patent claims not infringed and invalid.

2/2013 – 10/2013 **Client: Seyfarth Shaw LLP (representing Motorola Mobility LLC)**

Case: University of Florida Research Foundation, Inc. and Rapid Mobile Technologies, Inc. v. Motorola Mobility LLC

Civil Action No. 13-cv-61120-KMM-EGT

Location: UNITED STATES DISTRICT COURT FOR THE SOUTHERN DISTRICT OF FLORIDA – Hon. K. Michael Moore, Magistrate Judge: Hon. Edwin G. Torres

Testifying expert in this employment law case involving mobile device testing systems.

Expert Reports:

3-1-13 Expert Report regarding Non-Infringement

4-1-13 Declaration in Opposition to Plaintiff's MSJ

Attorneys: For Plaintiff: Meltzer & Mathis

For Defendant: Seyfarth Shaw LLP

Status: Case settled

5/2012 – 4/2013 **Client: Paul Hastings LLP (representing Apple, Inc.)**

Case: SmartPhone Technologies, LLC v Research in Motion Corporation, et. al.

Case No. 6:10-cv-00074

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS TYLER DIVISION – Hon. John D. Love

Testifying expert in this patent case involving 3GPP technology.

Expert Reports:

12-31-12 Appendix A to Rebuttal Expert Report of Dr. David Wilson

3-13-13 Appendix A to Supplemental Expert Report of Dr. David Wilson

Attorneys: For Plaintiff: Mintz Levin Cohn Ferris Glovsky and Popeo PC

For Defendant: Paul Hastings LLP

Status: Case settled

8/2012 – 9/2013 **Client: Reed & Scardino, LLP (representing EON Corp. IP Holdings, LLC)**

Case: EON Corp. IP Holdings, LLC v. SKYGUARD, LLC et. al.

Case No. 6:11-cv-00015-LED

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF

TEXAS TYLER DIVISION – Hon. John D. Love

Testifying expert in this patent case involving RF technology for WiFi networking.

Expert Reports:

2-15-13 Expert Report regarding Infringement

Videotaped Deposition:

4-09-13

Attorneys: For Plaintiff: Reed & Scardino, LLP

For Defendant: K&L GATES LLP

Status: Case settled

5/2012 – 6/2014 **Client: Reed & Scardino LLP (representing Eon Corp. IP Holdings)**

Case: Eon Corp. IP Holdings, LLC v. Landis+Gyr, Inc., et. al.

Case No. 6:09-cv-00317-LED-JDL

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS
TYLER DIVISION – Hon. John D. Love

Testifying expert in this patent case involving two-way wireless networks, before Judge Love.

Expert Report:

7-8-13 Expert Report regarding Infringement by Silver Spring Networks, Inc.

7-8-13 Expert Report regarding Infringement by Itron, Inc.

Videotaped Deposition: September 12, 2013

Live Testimony at Jury Trial: June 2, 2014 – June 6-2014

Attorneys: For Plaintiff: Reed & Scardino LLP

For Defendant: Dentons, LLP

Status: Jury award. All patents found valid and infringed.

3/2012 – 3/2014 **Client: Perkins Coie (representing Intel Corporation)**

Case: Stragent LLC, et. al. v. Intel Corp.,

Case No. 6:11-cv-421-LED (E.D. Tex.)

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF
TEXAS TYLER DIVISION – Hon. Timothy Dyk, Hon. John D. Love

Testifying expert in this patent case involving the use of error detection technology in computer networking, before Judge Dyk.

Expert Reports:

08-23-13 Expert Report regarding Invalidity

09-23-13 Expert Report regarding Non-Infringement

Videotaped Deposition:

10-08-13, and 10-09-13

Jury trial testimony:

3-13-2014 Live trial testimony on non-infringement and invalidity before Judge Timothy Dyk

Attorneys: For Plaintiff: Nelson, Bumgardner & Casto

For Defendant: Perkins Coie

Status: Jury verdict for non-infringement and invalidity

2/2012 – 09/2015 **Client: Dewey & LeBoeuf LLP (representing Harris Corporation)**

Case: Harris Corporation v. Ruckus Wireless, Inc.

Case No. 6:11-cv-00618-CEM-CRS

Location: UNITED STATES DISTRICT COURT FOR THE MIDDLE DISTRICT OF FLORIDA ORLANDO DIVISION – Hon. Charlene Edwards Honeywell

Testifying expert in this patent case involving RF technology for WiFi networking.

Expert Reports:

3-5-12 Expert Report regarding Infringement

3-6-12 Supplemental Expert Report regarding Infringement

4-6-12 Expert Report regarding Validity

Declarations:

5-30-12 Declaration ISO Claim Construction

6-18-12 Declaration ISO Markman Motion

1-23-15 Declaration ISO Responsive Markman Brief

3-6-15 Supplemental Expert Report regarding Infringement

4-3-15 Rebuttal Expert Report regarding Validity

Videotaped Deposition:

4-30-12

Attorneys: For Plaintiff: Dewey & LeBeouf LLP

For Defendant: Lewis and Roca LLP

Status: Case settled

2/2012 – 2/2013 **Client: Common-Interest-Group (representing Nokia, Huawei, ZTE)**

Case: InterDigital Communications LLC, et. al. v. Huawei Tech Co., LTD., et. al.

Certain Wireless Devices With 3G Capabilities and Components Thereof

U.S. Int'l Trade Commission Inv. No. 337-TA-800

Location: UNITED STATES INTERNATIONAL TRADE COMMISSION –
Administrative Law Judge Hon. David P. Shaw and Administrative Law Judge
Hon. Theodore R. Essex

Testifying expert in this patent case involving 3G wireless, WiFi, and WCDMA
technology.

Expert Reports:

11-30-12 Expert Report regarding Non-infringement

7-31-12 Expert Report regarding Invalidity

11-19-10 Rebuttal Expert Report regarding Validity

12-6-10 Supplemental Expert Report regarding Infringement

Videotaped Deposition:

12-14-12, 12-15-12

ITC Trial testimony:

2-6 through 2-15/13 Non-infringement and Invalidity witness statements, live
testimony

Attorneys: For Plaintiff: Latham & Watkins, LLP

For Defendant: Alston & Bird, Covington & Burling, Brinks Hofer

Status: ITC hearing verdict: All patents not infringed and invalid

9/2010 – 4/2011 **Client: Reed & Scardino LLP (representing Eon Corp. IP Holdings)**

Case: Eon Corp. IP Holdings, LLC v. Sensus USA, Inc., et. al.

Case No. 6:09-cv-00116-LED-JDL

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS

TYLER DIVISION – Hon. John D. Love

Testifying expert in this patent case involving two-way wireless networks

Expert Report:

10-22-10 Expert Report regarding Infringement (Sensus USA, Inc)

11-7-10 Expert Report regarding Infringement (Bell Industries)

11-19-10 Rebuttal Expert Report regarding Validity

12-6-10 Supplemental Expert Report regarding Infringement

Declaration:

12-28-10, 1-18-11

Videotaped Deposition:

12-8-10, 2-3-11

Attorneys: For Plaintiff: Reed & Scardino LLP

For Defendant: Jones Day

Status: Case settled

10/2009 – 2/2010 **Client: White & Case LLP (representing Marvell)**

Case: Marvell Semiconductor, Inc., et. al. v. Commonwealth Scientific Industrial Research Organisation

Case No. 6:07-CV-204 (LED)

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS
TYLER DIVISION – Hon. Leonard Davis

Testifying expert in this patent case involving wireless LAN protocols.

Expert Report:

11-24-09 Rebuttal Expert Report

Videotaped Deposition:

01-07-10

Attorneys: For Plaintiff: White & Case LLP

For Defendant: Townsend and Townsend and Crew LLP

Status: Case settled

9/2009 – 2/2010 **Client: Perkins Coie Brown & Bain PA (representing Intel)**

Case: Saxon Innovations, LLC v. Apple, Inc., et. al.

Case No. 6:08-cv-00265-LED

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS TYLER DIVISION – Hon. John D. Love

Testifying expert in this patent case involving wireless technology.

Declarations:

12-04-09 Declaration Regarding Claim Construction

Videotaped Deposition:

01-19-10

Attorneys: For Plaintiff: Susman Godfrey LLP

For Defendant: Perkins Coie Brown & Bain LLP

Status: Case settled

8/2008 – 10/2009 **Client: Reed & Scardino LLP (representing Eon Corp. IP Holdings)**

Case: Eon Corp. IP Holdings, LLC v. Verizon Clinton Center Drive Corp., et. al.

Case No. 6:08-cv-00385

Location: UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF TEXAS TYLER DIVISION – Hon. John D. Love

Testifying expert in this patent case involving two-way wireless networks

Expert Report:

06-22-10 Expert Report

08-16-10 Supplemental Expert Report

Videotaped Depositions:

08-18-10, 08-26-10

Attorneys: For Plaintiff: Reed & Scardino LLP

For Defendant: Simpson Thacher & Bartlett LLP

Status: Case settled

4/2008 – 3/2009 **Client: McDermott, Will & Emery LLP (representing GE Licensing)**

Case: CIF Licensing, LLC d/b/a GE Licensing v. Agere Systems, Inc.

Case No. 07-170 (JJF)

Location: UNITED STATES DISTRICT COURT FOR THE DISTRICT OF DELAWARE

– Hon. Joseph. J. Farnan, Jr.

Testifying expert in this patent case involving modem technology.

Expert Report:

09-05-08 Rebuttal Expert Report

Non-videotaped Depositions:

9-24-08, 9-26-08

Jury trial testimony:

2-04-09

Attorneys: For Plaintiff: McDermott, Will & Emery LLP

For Defendant: Townsend and Townsend and Crew LLP

Status: Jury award. 2 patents infringed and valid, remaining 2 patents non-infringed

2/2008 – 5/2010, **Client: Simpson Thacher & Bartlett LLP (representing Cisco Systems, Inc.)**
2/2011 – 4/2011

Case: Commil USA, LLC v. Cisco Systems, Inc., et. al.

Case No. 2:07-CV-341-DF-CE

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION – Hon. Charles Everingham IV

Testifying expert on invalidity regarding short range communication protocols.

Opening Expert Report

12-23-09

Videotaped Depositions:

02-09-10

Attorneys: For Plaintiff: Sayles Werbner

For Defendant: Simpson Thacher & Bartlett LLP

Status: Jury award for original trial and retrial: patents found valid and infringed.

6/2007 – 4/2009 **Client: Common Interest Group of Co-Defendants**

11/2010 – 4/2012 **Client: Common Interest Group of Co-Defendants**

Case: Commonwealth Scientific and Industrial Research Organisation v. Toshiba
America Information Systems, Inc., et. al.

Case No. 6:06-cv-00550-LED

Case No. 6:09-CV-0399 (LED)

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS
TYLER DIVISION – Hon. Leonard Davis

Testifying expert in this patent case involving wireless LAN technology.

Declarations:

06-05-08 Regarding claim construction

12-17-08 Supporting opposition to summary judgment

04-05-09 Supporting motion for reconsideration

02-24-12 Supporting opposition to summary judgment

Expert Reports:

10-08-08 Rebuttal Expert Reports- Re: TI Chips, Re: Marvell Chips, Re: Airgo
Chips, Re: Broadcom Chips, Re: Conexant Chips, Re: Ralink Chips, Re: Atheros
Chips

01-27-12 Rebuttal Expert Reports- Re: TI Chips, Re: Broadcom Chips, Re:
Ralink Chips, Re: Atheros Chips

Videotaped Depositions:

11-1-08, 11-2-08, 02-14-12

Attorneys: For Plaintiff: Townsend & Townsend LLP

For Defendant: Keker & Van Nest, LLP

Status: Jury trial: patents found valid and infringed.

10/2006 – 8/2009 **Client: Keker & Van Nest (representing Comcast Corporation)**

Case: Rembrandt Technologies, Inc. v. Comcast Corporation

Case No. 2-05-CV-000443 (TJW)

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION – Hon. T. John Ward

Testifying expert in this patent case involving physical layer and data link layer
communication protocols for cable networks.

Declaration:

01-10-07 Support of Claim Construction Brief

Videotaped Deposition:

12-22-06 Regarding claim construction opinions

Attorneys: For Plaintiff: McKool Smith
For Defendant: Keker & Van Nest
Status: Case settled

3/2007 – 5/2007 **Client: Niro, Scavone, Haller and Niro (representing MLR, LLC)**

Case: MLR, LLC v. Kyocera Wireless Corporation and Novatel Wireless, Inc.
Case No. 05-CV-0935 B (AJB)

Location: UNITED STATES DISTRICT COURT SOUTHERN DISTRICT OF CALIFORNIA

Testifying expert in this patent case involving cellular phone technology.

Expert Report:

04-20-07 Expert Report regarding infringement

Attorneys: For Plaintiff: Niro, Scavone, Haller, and Niro
For Defendant: Hogan & Hartson, LLP

Status: Case settled

6/2006 – 10/2006 **Client: Thompson & Knight (representing Ericsson, Inc.)**

Case: Fenner Investments, Ltd., v. Juniper Networks, Inc. et. al.
Case No. 2:05–CV–05 JDL

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF TEXAS MARSHALL DIVISION

Testifying expert in this patent case involving wireless communications services.

Expert report regarding infringement and invalidity

5-23-06 Rebuttal expert report regarding infringement and invalidity

Attorneys: For Plaintiff: Fulbright & Jaworski
For Defendant Ericsson: Thompson & Knight

Status: Case settled

12/2003 – 5/2006 **Client: Howrey LLP/ Winston & Strawn LLP (representing McKesson Information Solutions, Inc.)**

Case: McKesson Information Solutions, Inc. vs. Bridge Medical, Inc.
Case No. CIV S-02-2669 FCD KJM

Location: UNITED STATES DISTRICT COURT EASTERN DISTRICT OF
CALIFORNIA – Hon. Peter A. Nowinski

Testifying expert in this patent case involving a patient on a patient identification
and verification system that incorporates wireless technology.

Inequitable Conduct Trial live testimony:
5-04-06

Markman Hearing live testimony:
6-29/30-05

Videotaped Depositions:
2-14-04, 6-3-05

Declarations:
12-1-03 Dec. in support of MISI's Opening/Opposition re Claim Construction
12-24-04 Dec. in support of MISI's Motion for Preliminary Injunction
3-1-04 Dec. in support of Claim Construction
6-29-04 Dec. re meaning of "Communication"
7/15/05 Dec. in support of MISI's Opposition to Bridge's Motion for
Summary Judgment

Attorneys: For Defendant: Morrison & Foerster

For Plaintiff: Howrey Simon, Winston & Strawn, Morgan Lewis

Status: Bench trial on inequitable conduct: Verdict found inequitable conduct.

07/2003–02/2006 **Client: Heller Ehrman LLP (representing Texas Instruments, Inc.)**

Case: Texas Instruments, Inc. and Stanford University vs. GlobespanVirata, Inc.

Provided discovery of evidence used at trial, concerning the structure and
operation of Globespan's ADSL products, and supported litigators in depositions
of Globespan engineers.

Attorneys: For Plaintiff: Heller Ehrman

For Defendant: Covington & Burling, LLP

Status: Jury award.

Patents

<u>Patent Number</u>	<u>Date Issued</u>	<u>Title</u>
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10,332,121	June 25, 2019	Light-based Data Entry for Personal Inventory and Product Support System
9,978,037	May 22, 2018	Personal inventory and product support system
8,995,996	March 31, 2015	Methods and apparatus for performance optimization of heterogeneous wireless system communities
8,935,580	January 13, 2015	Multimedia-aware quality-of-service and error correction provisioning
8,468,426	June 18, 2013	Multimedia-aware quality-of-service and error correction provisioning
8,189,538	May 29, 2012	Reconfiguration of a communication system
8,144,640	March 27, 2012	Location tracking in a wireless communication system using power levels of packets received by repeaters
8,064,380	November 22, 2011	Reconfiguration of a communication system
8,027,637	September 27, 2011	Single frequency wireless communication system
7,957,741	June 7, 2011	Token-based receiver diversity
7,876,704	January 25, 2011	Tunneling protocols for wireless communications
7,689,210	March 30, 2010	Plug-n-playable wireless communication system
7,672,274	March 2, 2010	Mobility support via routing
7,668,542	February 23, 2010	Token-based receiver diversity
7,515,557	Apr 7, 2009	Reconfiguration of a communication system
7,236,470	Jun 26, 2007	Tracking multiple interface connections by mobile stations
7,149,196	Dec 12, 2006	Location tracking in a wireless communication system using power levels of packets received by repeater
6,965,769	Nov 15, 2005	Testing Center
6,862,448	Mar 1, 2005	Token-based receiver diversity
6,788,658	Sep 7, 2004	Wireless communication system architecture having split MAC layer
6,760,318	Jul 6, 2004	Receiver diversity in a communication system
6,557,134	Apr 29, 2003	ARQ method for wireless communication
6,259,911	Jul 10, 2001	Network operations center hardware and software design

Education

<u>Year</u>	<u>College/University</u>	<u>Degree</u>
1993	Stanford University	PhD, Electrical Engineering Thesis: “Trellis Coding for Multi-Level, Partial-Response Continuous Phase Modulation with Precoding”
1988	Stanford University	MS, Electrical Engineering
1985	Rensselaer Polytechnic Institute	BS, Computer and Systems Engineering

Publications

Goldhamer, M., Grandblaise, D., Bims, H., Feng, S., Piggin, P., Sydor, J., and Wu, X. “Coexistence between 802.16 Systems Operating in Shared Bands”, *Radio Resource Management in WiMAX*, John Wiley & Sons, 2009.

Bims, Harry. “Surveying the Wireless LANdscape. Or Why Large Wi-Fi Networks Require Good Planning.” *Xchange*. [Online] Available <http://www.xchangemag.com/articles/391supsys1.html>, September 1, 2003.

Bims, Harry. “Building Voice-Ready Wireless LANs” *Wireless Week*. [Online] Available <http://www.wirelessweek.com/article/CA319429.html?spacedesc=Departments>, September 1, 2003.

Bims, Harry. “Enabling Voice over WLANs”. White Paper. [Online] Available. http://airflownetworks.com/solutions/pdf/vowlan_wp.pdf. September 2003.

Bims, Harry. “Securing Enterprise WLANs”. White Paper. [Online] Available. http://web.archive.org/web/20040303212529/airflownetworks.com/solutions/pdf/securing_wlans_wp.pdf. August 2003.

Bims, H. and Cioffi. J. “Trellis Coding for Full-Response CPM”, *Third Generation Wireless Information Networks*, Kluwer Academic Publishers, 1992.

Bims, H. and Cioffi. J. “Trellis Coding for Full-Response CPM”, *WINLAB WORKSHOP*, East Brunswick, NJ. October 18-19, 1990.

Bims, H. and Cioffi, J. “Trellis Coding for Partial-Response CPM”, *1991 International Symposium on Information Theory*, Budapest, Hungary. June 24-28, 1991.

Bims, H. and Cioffi, J. “Trellis Coding with M-ary MSK Constraints”, *GLOBECOM '89*, Dallas TX. Nov. 1989.

Professional Associations and Achievements

- Jan 2009 – Present Vice-Chair and Board of Directors, Menlo Park Chamber of Commerce
- Nov 2007 – Sep 2010 Vice-Chair and Secretary, IEEE 802.16h License Exempt Group
- Feb 2002 – Jan 2011 Member, City of Menlo Park Planning Commission
(2006 Chairperson, 2005 Vice-Chairperson)
- Feb 2012 – Present Senior Member, IEEE
- Jan 2000 – Dec 2000 Chair, IEEE Engineering Management Society – Silicon Valley Chapter
- Jun 1985 - Jun 1991 AT&T Bell Laboratories Cooperative Research Fellow