

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

TOGAIL TECHNOLOGIES LTD.,
Patent Owner.

IPR2023-00645
U.S. Patent No. 10,743,238

**DECLARATION OF DR. ZHI DING, PH.D.,
UNDER 37 C.F.R. § 1.68 IN SUPPORT OF PETITION FOR
INTER PARTES REVIEW**

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I, Dr. Zhi Ding, do hereby declare as follows:

I. INTRODUCTION

1. I am making this declaration at the request of Apple Inc. in the matter of the *Inter Partes* Review of U.S. Patent No. 10,743,238 (“the ’238 patent”) to Chen, *et al.*

2. I am being compensated for my work on this matter and for reasonable and customary expenses associated with my work and testimony in this investigation. My compensation is not contingent on the outcome of this matter or the specifics of my testimony, and I have no other interest in this case or the parties thereto.

3. I have been asked to provide my opinions regarding whether claims 1-5 and 11-15 (“the Challenged Claims”) of the ’238 patent are patentable, or whether they would have been obvious to a person having ordinary skill in the art (“POSITA”) at the time of the alleged invention, in light of the prior art. It is my opinion that all of the limitations of the challenged claims would have been obvious to a POSITA.

4. In the preparation of this declaration, I have studied:

- a. the ’238 patent, Ex.1001;
- b. the prosecution history of the ’238 patent (“’238 File History”),

Ex.1002;

- c. Declaration of Mr. Craig Bishop under 37 C.F.R. § 1.68, Ex.1005;
- d. 3GPP TSG RAN WG2 Meeting #99bis R2-1711767, “Discussion on the granularity of SI change notification,” Source: ITRI, Ex.1007;
- e. U.S. Patent No. 10,505,803 to Liao, Ex.1008;
- f. U.S. Provisional Patent Application No. 62/544,118 to Liao, Ex.1009;
- g. U.S. Patent Publication No. 2019/0132824 to Jeon et al., Ex.1010;
- h. U.S. Provisional Patent Application No. 62/577,995 to Jeon et al., Ex.1011;
- i. 3GPP TSG RAN WG1 NR Ad Hoc Meeting R1-1709972, “Overview of wider bandwidth operations,” Source: Huawei, HiSilicon, Ex.1012;
- j. U.S. Patent Publication No. 2019/0260530 to Yi et al., Ex.1013;
- k. Draft Report of 3GPP TSG RAN WG1 Meeting #90bis v0.1.0 R1-171xxxx, Source: MCC Support, Ex.1014;
- l. 3GPP TSG RAN WG2 Meeting #99bis R2-1710181, “Discussion on NR SI Modification,” Source: OPPO, Ex.1015;
- m. U.S. Patent Publication No. 2019/0182884 to Deenoo et al., Ex.1016;
- n. U.S. Patent Publication No. 2019/0053029 to Agiwal et al., Ex.1017;
- o. U.S. Provisional Patent Application No. 62/543,581 to Agiwal et al., Ex.1018;

- p. 3GPP TSG RAN WG1 Meeting #90bis R1-1718327, “Remaining Details on Bandwidth Part Operation in NR,” Source: MediaTek, Ex.1019;
- q. 3GPP TSG RAN WG1 Meeting #90bis R1-1718580, “Open Issues on BWP,” Source: Qualcomm, Ex.1020;
- r. 3GPP TSG RAN WG1 Meeting #90 R1-1713654, “Wider Bandwidth Operations,” Source: Samsung, Ex.1021;
- s. WDTX case 622-cv-00326, Plaintiff’s Infringement Contentions, Exhibit A (’238), served Oct. 3, 2022, Ex.1022;
- t. PCT Publication No. WO 2019/068224 to Dawid et al., Ex.1023;
- u. U.S. Patent Publication No. 2018/0234917 to Kim et al., Ex.1024;
- v. U.S. Patent Publication No. 2016/0192292 to Hoglund et al., Ex.1025;
- w. U.S. Patent Publication No. 2014/0106793 to Lee et al., Ex.1026; and
- x. U.S. Patent No. 10,237,810 to Nigam et al., Ex.1027.

5. In forming the opinions expressed below, I have considered:

the documents listed above;

the relevant legal standards, including the standard for obviousness, and any additional authoritative documents as cited in the body of this declaration; and

my own knowledge and experience based upon my work in the field of networking as described below, as well as the following materials.

6. Unless otherwise noted, all emphasis in any quoted material has been added.

II. QUALIFICATIONS AND PROFESSIONAL EXPERIENCE

7. I presently hold the title of Distinguished Professor in the Department of Electrical and Computer Engineering at the University of California, Davis. Since my appointment on July 1, 2000, I have held the position of professor for the past 22 years at the present university and have served as a faculty member at several US universities for over 30 years. I am also a private technical consultant on various technologies related to information systems. I have more than three decades of research experience on a wide range of topics related data communications and signal processing.

7. I earned my Bachelor of Science degree in 1982 in wireless engineering from the Nanjing Institute of Technology (later renamed as Southeast University) in Nanjing, China. I earned my Master of Science degree in 1987 in electrical engineering from the University of Toronto in Toronto, Canada. I earned my Ph.D. in 1990 in electrical engineering from Cornell University in Ithaca, New York.

8. My responsibilities as a Professor at University of California, Davis, include classroom instruction on various topics of communication systems and signal analysis, as well as mentoring undergraduate students and supervising

graduate students in their research and development efforts on various topics related to digital communications. I have directly supervised such research and development works ranging from signal detection to wireless networking. As the chief academic advisor, I have also directly supervised the completion of over 20 Masters theses and 30 Ph.D. dissertations on various topics related to digital communications. I have served full time as a faculty member at three major research universities in the United States over the past 30 years, including Auburn University from 1990 to 1998, University of Iowa from 1999 to 2000, and University of California, Davis, from 2000 to present.

9. Since 1990, I have been selected as the principal investigator of multiple highly competitive federal and local research grants, including more than twenty major research projects supported by the National Science Foundation and two research projects funded by the U.S. Army Research Office. These competitive research projects focused on developing more efficient and effective digital communication transceivers, networks, and signal processing tools. I have also participated in several large-scale projects supported by the Defense Advanced Research Projects Agency (DARPA) with teams of researchers. I have applied for, and received support from, other federal, state, and industry sponsors.

10. I have published over 210 peer-reviewed research articles in premier international journals, in addition to over 240 refereed technical articles at top

international conferences on communications and information technologies.

According to Google Scholar, my published works have been cited by over 13,000 times by peers. I also authored two books on communications technologies. My most recent book, coauthored with B.P. Lathi, is entitled, “Modern Digital and Analog Communication Systems,” 5th edition, and was published by the Oxford University Press in 2018. The 4th edition of this book (published in 2009) had been widely adopted as an introductory textbook to communication systems.

11. In addition to the over 450 published technical papers that have been cited over 16,000 times according to Google Scholar¹, I am also co-inventor of 4 issued U.S. patents on communication technologies.

12. I am a member of the Institute of Electrical and Electronics Engineers (IEEE) and was elevated to the grade of Fellow in January 2003 for contributions made in signal processing for communication. The IEEE is the world’s largest professional society of engineers, with over 400,000 members in more than 160 countries. The IEEE has led the development of many standards for modern digital communications and networking, most notably, the IEEE 802 series of network standards. The IEEE Grade of Fellow is conferred by the Boards of Directors upon a person with an extraordinary record of accomplishments in any of the IEEE

¹ <https://scholar.google.com>, as of Feb. 24, 2023.

fields of interest. The total number selected in any one year does not exceed one-tenth of one percent of the total voting Institute membership.

13. I have served the IEEE in the following capacities:

- Chief Information Officer of the IEEE Communications Society from Jan. 2018 to present.
- Chief Marketing Officer of the IEEE Communications Society from Jan. 2020 to present.
- General Chair of the 2016 IEEE International Conference on Acoustics, Speech, and Signal Processing, the flagship conference of the IEEE Signal Processing Society.
- Chair of the Steering Committee for the IEEE Transactions on Wireless Communications from 2008 to 2010.
- Distinguished Lecturer of the IEEE Communications Society from January 2008 to December 2009.
- Technical Program Chair of the 2006 IEEE Globecom, one of two flagship annual IEEE Communication Society conferences.
- Distinguished Lecturer of the IEEE Circuits and Systems Society from 2004 to 2005.
- Associate Editor of the IEEE Transactions on Signal Processing from 1994 to 1997 and from 2001 to 2004.

- Member of the IEEE Statistical Signal and Array Processing for Communications Technical Committee from 1993 to 1998.
- Member of the IEEE Signal Processing for Communications Technical Committee from 1998 to 2004.

14. In 2012, I received the Wireless Communications Technical Committee Recognition Award from the IEEE Communications Society, an award given to a person with a high degree of visibility and contribution in the field of “Wireless and Mobile Communications Theory, Systems, and Networks.” I received the 2020 Education Award from the IEEE Communications Society. According to the Society, this award “recognizes distinguished and significant contributions to education within the Society’s technical scope.”

15. I have also served as a technical consultant for the telecommunication industry. For example, in 1995 I consulted for Analog Devices, Inc., on the development of the first generation DOCSIS cable modem systems. I have also consulted for other companies, including Nortel Networks and NEC US Laboratories. I worked as a visiting faculty research fellow at NASA Glenn Research Center in 1992 and at U.S. Air Force Wright Laboratory in 1993. I have served on multiple review panels of the National Science Foundation to evaluate competitive research proposals in the field of communication. I have also reviewed a large number of research proposals at the request of the National Science and

Engineering Research Council (NSERC) of Canada as an expert panelist from 2010 to 2013, and also at the request of the Research Grant Council (RGC) of Hong Kong as an external reviewer.

16. I have served as an expert witness or consulting expert on a number of matters related to intellectual property, mostly in the arena of telecommunications, including cellular communications, Wi-Fi technologies, Bluetooth, and optical communications. For example, since 2007, I have been engaged to work on various litigations involving cellular, WiFi, Bluetooth, and optical communication networks.

17. Based on my above-described near three decades of experience in communications technologies, and the acceptance of my publications and professional recognition by societies in my field, I believe that I am qualified to be an expert in wireless communication systems, communication networks, and signal processing.

18. My complete qualifications and professional experience are described in my *Curriculum Vitae*, a copy of which can be found in Exhibit 1004.

III. LEVEL OF ORDINARY SKILL IN THE ART

19. I understand there are multiple factors relevant to determining the level of ordinary skill in the pertinent art, including (1) the levels of education and experience of persons working in the field at the time of the invention; (2) the

sophistication of the technology; (3) the types of problems encountered in the field; and (4) the prior art solutions to those problems.

20. It is my understanding that the earliest possible priority date for the '238 patent is Nov. 15, 2017. I am familiar with the wireless communications art pertinent to the '238 patent. I am also aware of the state of the art at the time of the alleged priority date. Based on the technologies disclosed in the '238 patent, a person of ordinary skill in the art ("POSITA") in the field of the '238 patent, as of the earliest possible priority date of Nov. 15, 2017, would include someone who had at least a master's degree from an accredited program in electrical engineering, computer engineering, computer science, or a related field, and three years of relevant experience in mobile communications or wireless networks, or a Ph.D. degree in the disciplines listed above and one year of relevant experience. Moreover, I recognize that someone with more technical education, but less experience could have also met this standard. I believe that I possessed and exceeded such experience and knowledge before and at the priority date and that I am qualified to opine on the '238 patent.

21. For purposes of this Declaration, in general, and unless otherwise noted, my statements and opinions, such as those regarding my experience and the understanding of a POSITA generally (and specifically related to the references I consulted herein), reflect the knowledge that existed in the field as of the earliest

alleged priority date of the '238 patent (i.e., Nov. 15, 2017). Unless otherwise stated, when I provide my understanding and analysis below, it is consistent with the level of a POSITA as of the alleged priority date of the '238 patent.

IV. RELEVANT LEGAL STANDARDS

22. I am not an attorney. In preparing and expressing my opinions and considering the subject matter of the '238 patent, I am relying on certain basic legal principles that counsel have explained to me. These principles are discussed below.

23. I understand that prior art to the '238 patent includes patents and printed publications in the relevant art that predate the priority date of the alleged invention recited in the '238 patent.

24. I have been informed that a claim preamble may or may not limit the claim scope. For the purposes of this *Inter Partes* Review, I have been informed by counsel to include the preamble in the analysis for obviousness in order to follow a conservative approach.

25. I have been informed that a claimed invention is unpatentable under 35 U.S.C. § 103 if the differences between the invention and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. I have also been informed by counsel that the obviousness analysis

takes into account factual inquiries including the level of ordinary skill in the art, the scope and content of the prior art, and the differences between the prior art and the claimed subject matter.

26. I have been informed that a threshold inquiry as to whether a reference can be considered in the obvious analysis is whether the reference is analogous art to the claimed invention. A reference is analogous art to the claimed invention if: (1) the reference is from the same field of endeavor as the claimed invention (even if it addresses a different problem); or (2) the reference is pertinent to the problem faced by the inventor (even if it is not in the same field of endeavor as the claimed invention).

27. I have been informed by counsel that the Supreme Court has recognized several rationales for combining references or modifying a reference to show obviousness of claimed subject matter. Some of these rationales include the following: (a) combining prior art elements according to known methods to yield predictable results; (b) simple substitution of one known element for another to obtain predictable results; (c) use of a known technique to improve a similar device (method, or product) in the same way; (d) applying a known technique to a known device (method, or product) ready for improvement to yield predictable results; (e) choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; and (f) some teaching, suggestion, or motivation

in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

28. Also, I have been informed and understand that obviousness does not require physical combination or bodily incorporation but rather consideration of what the combined teachings of prior art references would have suggested to a POSITA at the time of the alleged invention.

V. OVERVIEW OF THE RELATED TECHNOLOGY

29. The '238 patent relates, in part, to a 5G cellular network. '238 patent, Abstract, 3:49-50. The 5G cellular network includes functionalities that are the same as the prior 4G (LTE) network, including the concept of system information (SI). It was well known in the prior art, including by the 5G working groups, that 5G could include paging notifications when the SI is updated by the network and would also include the frequency partitioning scheme called bandwidth parts (BWPs). Bishop Declaration, ¶¶46-60. The following discusses of SI updates and BWPs in more detail.

A. Remaining Minimum System Information (RMSI)

30. It was commonly known that when a cellular phone user first turns on the wireless terminal device, also known as user equipment (UE), the UE needs to know certain parameters or information about the network to function properly.

This information about the cellular network or system is called system information (SI). In a 5G cellular network (as well as 3G and 4G), after powering on, the UE may acquire the first piece of SI: the master information block (MIB). The MIB is repeatedly broadcast by all network base stations so that it is easily accessible to UEs that initially had little or no other information about the system. ITRI, 1; Yi, [0091]; Draft Minutes RAN1#90b, 55-56.

31. The MIB includes information on where the UE can acquire additional pieces of SI that the UE needs. One such information is called SI block 1 (SIB1). The MIB includes the time and frequency scheduling information of what is known as a “search space” for the UE to monitor for SIB1. The UE scans this search space to find and receive a broadcast of SIB1. ITRI, 1.

32. The UE needs both MIB and SIB1 before it can enter a connected mode to, for example, make calls and exchange other data. Together, these pieces of SI—MIB and SIB1—are referred to as “required SI” or “minimum SI.” ITRI, 1; OPPO, 1. Once the UE has MIB, the UE still needs the “remaining minimum system information” (RMSI) to enter connected mode; that is, the UE still needs SIB1. The terms SIB1 and RMSI are sometimes used interchangeably in the prior art. ITRI, 1-2; Draft Minutes RAN1#90b, 68; OPPO, 2.

33. Because the RMSI (SIB1) needs to be readily available, so that all UEs in the network could potentially enter and maintain connected mode, the

frequency band scheduling location of RMSI is included in MIB, which is repeatedly broadcasted. Huawei, 2. The RMSI, in turn, includes scheduling information for other SI blocks (SIBs) used during connected mode. ITRI, 1-3; OPPO, 2. These other SIBs are called SIB2, SIB3, SIB4, etc. While each UE needs at least MIB and RMSI (SIB1) to enter connected mode, it may or may not need some of these other SIBs (SIB2, etc.). OPPO, 2.

34. Typically, for a UE to enter connected mode, it will have to acquire at least some of these other SIBs that are scheduled in the RMSI. Each of these other SIBs is associated with an integer number value, called a “value tag,” which is used for determining whether the corresponding SIB has been updated. ITRI, 2. For example, if RMSI indicates that SIB2 is available with a different value tag than the version of SIB2 already downloaded and stored in the UE, then the UE knows it needs to reacquire SIB2 to ensure it has up-to-date system information for maintaining connected mode. ITRI, 2. It was thus commonly known that these SIBs (SIB2, SIB3, etc.) may be updated over time.

35. Similarly, it was commonly known that the RMSI or SIB1 itself may be updated over time; for instance, the value tags of other SIBs listed in SIB1 may change. ITRI, 1. The UE then needs to reacquire the updated RMSI to maintain connected mode. ITRI, 2. The UE may locate RMSI based on the frequency band scheduling information provided in MIB, which is the same way the UE locates

RMSI after powering on. ITRI, 1-2.

36. When there is an SI update, the 5G network may broadcast a notification to all UEs, which is the same procedure of the prior 4G (LTE) network. ITRI, 1-2; Nigam, 4:1-11. The SI update notification may be a paging message, which is a short message that can be quickly processed, so as to minimize downlink transmission resources as well as receiver power at the UE. ITRI, 2; Liao, 48-51; Kim, ¶0284. If the UE receives the SI update notification, the UE may reacquire RMSI/SIB1 from the frequency location indicated in the MIB to maintain connected mode. '238 patent, 1:35-41; ITRI, 2.

B. Frequency Bandwidth Parts (BWPs)

37. It was common knowledge among POSITAs who would have been familiar with 3GPP that both 4G and 5G networks could include UEs utilizing variable bandwidths in frequency space using “carrier aggregation,” where 5G could include further dividing component carriers into “bandwidth parts” (BWPs). Nigam, 4:28-33; Draft Minutes RAN1#90b, 68, 88.

38. The prior generation 4G (LTE) system could divide available frequency space into “component carriers” (CCs), and a UE can use more than one CC if it needs more bandwidth. This concept of dividing frequency space into CCs, which can be aggregated together to enlarge UE bandwidth to increase data rate, is referred to as “carrier aggregation.” Nigam, 4:28-33. In a network with carrier

aggregation, the UE powers on and initially uses a primary component carrier (CC), which is essentially an initial frequency band, and later adds one or more secondary CC(s) to increase data rate. The UE only monitors for SIB1 in the primary or initial carrier. Nigam, 4:28-33. 5G likewise includes carrier aggregation. ITRI, 1-2.

39. Additionally, 5G could include a frequency partitioning concept called “bandwidth parts” (BWPs). Draft Minutes RAN1#90b, 68, 88. That is, a single primary component carrier can be divided into frequency sub-bands or parts called BWPs. Jeon, ¶¶0276, 0290; Huawei, 2. One or more downlink BWP(s) and uplink BWP(s) can be configured for a UE. Jeon, ¶0277. The ’238 patent and following discussion refer to downlink BWPs.

40. Two main kinds of downlink BWPs were commonly known. First, the “initial active BWP” is defined as the location of RMSI. Draft Minutes RAN1#90b, 68. A UE that powers on or first attempts to access the network may read the broadcasted MIB, which tells the UE the frequency location of the RMSI and thus the initial active BWP. Draft Minutes RAN1#90b, 68. The initial active BWP has a relatively small bandwidth, as it is mainly used for system and control information. Jeon, ¶0269.

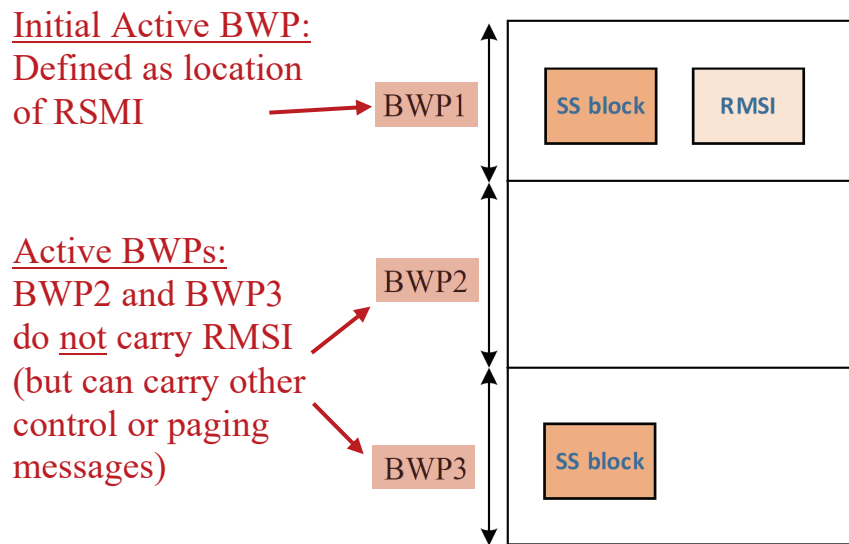
41. The second kind of BWP, referred to as a “currently active BWP” or simply “active BWP,” provides a larger bandwidth for UEs to receive data in

connected mode. Draft Minutes RAN1#90b, 68, 88. After the UE powers on or joins the network and acquires the RMSI from the initial active BWP, the UE may switch to an active BWP to receive more data in connected mode; and the UE may switch between an active BWP and the initial BWP as the UE's need for bandwidth changes over time. Jeon, ¶0272.

42. An active BWP, however, typically does not carry RMSI. '238 patent, 1:33-41; Huawei, Fig.1; Jeon, ¶¶0290, 0299. This allows the network to send more downlink data on the BWP, by not diverting resources to transmit RMSI. Jeon, ¶0290. Not including RMSI on active BWPs also frees up bandwidth for the UE, which does not have to monitor a search space for RMSI.

43. It was thus known in both 3GPP's 4G and 5G cellular systems to make RMSI (SIB1) available in the same frequency location for all UEs. Nigam, 4:28-33; Draft Minutes RAN1#90b, 68; Jeon, ¶0276. This way, the RMSI can be located no matter what frequency band or bandwidth is currently being used. In 5G, for example, the RMSI can always be located in the initial active BWP, and all UEs may know (from the MIB) the location of the frequency search space to monitor for the RMSI. Draft Minutes RAN1#90b, 68; Jeon, ¶0299. A POSITA thus would have known that the RMSI could be located on a specific BWP that is not expected to change over time and that the UE could switch to this initial active BWP when updated RMSI is available. Liao, 7:41-53.

44. The annotated figure below illustrates a 5G configuration of an initial active BWP (labeled BWP1), which carries RMSI, and other active BWPs (BWP2 and BWP3). Huawei, Fig.1. The active BWPs (BWP2 and BWP3) carry certain control information (paging messages) and other connected-mode data but do not carry RMSI. Jeon, ¶¶0290, 0297, 0299, 0376.



Huawei, Fig.1 (annotated to include Jeon, ¶¶0290, 0297, 0376).

C. System Information (SI) Updates

45. It was commonly known that in both 4G and 5G networks, a connected-mode UE may receive a paging message notification that the SI has been updated or changed. ITRI, 1-2; Nigam, 4:7-12. In response to the SI update notification, the UE may then reacquire RMSI (SIB1) according to the frequency scheduling information in MIB, since the UE's stored SIB1 or other SIBs may no

longer be valid. ITRI, 2-3; Nigam, 3:55-4:12; Liao, 7:41-53.

46. A 5G UE in connected mode may receive an SI update notification in a currently active bandwidth part, which does not carry RMSI. Jeon, ¶0290; Huawei, Fig.1. The UE, in order to maintain connected mode, may then switch to the initial active bandwidth part to reacquire RMSI/SIB1 and possibly other SIBs, e.g., if RMSI indicates a changed value tag(s). '238 patent, 1:35-41; Liao, 7:41-53; Jeon, ¶¶0276, 290. The background of the '238 patent itself explains this known concept: upon receiving notification of a “system information change, the Connected_UE may have to switch from the currently active BWP to the initial active BWP for accessing the [SI update].” '238 patent, 1:36-39.

47. It was also commonly known that the UE could switch between configured BWPs—e.g., from an active BWP to the initial active BWP—using one or more of any common broadcast and/or multicast signaling methods. Liao, 7:41-47. In particular, it was known for a BWP switch to occur based on a broadcasted paging message used for system information update. Liao, 7:41-53; Dawid, 16:20-21 (describing merging a BWP switch message and an SI update paging message into a single message). That is, once the UE receives the SI update paging message, it automatically or autonomously switches BWPs (i.e., to the initial active BWP). Liao, 7:41-53; Jeon, ¶0276. A paging message is a short-format message scrambled with a particular paging code that a UE recognizes. Draft Minutes

RAN1#90b, 53, 70; Dawid, 15:15-16. When the paging message is available in a search space or on a channel that is available to all UEs (e.g., without scheduling information), the paging message is broadcast. Liao, 7:48-51. A paging message is designed to convey a small amount information using a small amount of downlink resources. Jeon, ¶¶0290; Deenoo, ¶¶0173; Agiwal, ¶¶0081-0082. More downlink-resource intensive techniques for BWP switching include dedicated signaling, such as RRC layer signaling, or scheduled downlink control information (DCI) messages. Liao, 7:41-53; '238 patent, 1:30-32.

VI. BACKGROUND OF THE '238 PATENT

48. The '238 patent generally relates to a “user equipment (UE) for wireless communication” that needs to update its stored system information (SI) upon “receiving a system information change indication.” '238 patent, Abstract.

49. The '238 patent is directed in part to a “5G Access Network,” in which frequency bandwidth is partitioned into BWPs. '238 patent, 3:49-50, 1:25-30. The Background section describes it was known in 5G networks that a UE can be configured for one or more downlink (DL) BWPs but only uses one “active DL BWP” at a time. '238 patent, 1:25-30. According to the '238 patent, “an initial active DL BWP is defined as the frequency location and bandwidth dedicated for broadcasting remaining minimum SI (RMSI).” '238 patent, 1:33-35.

50. The '238 patent's Background section further describes it was already

known that the UE may need to switch BWPs in response to receiving a SI change indication:

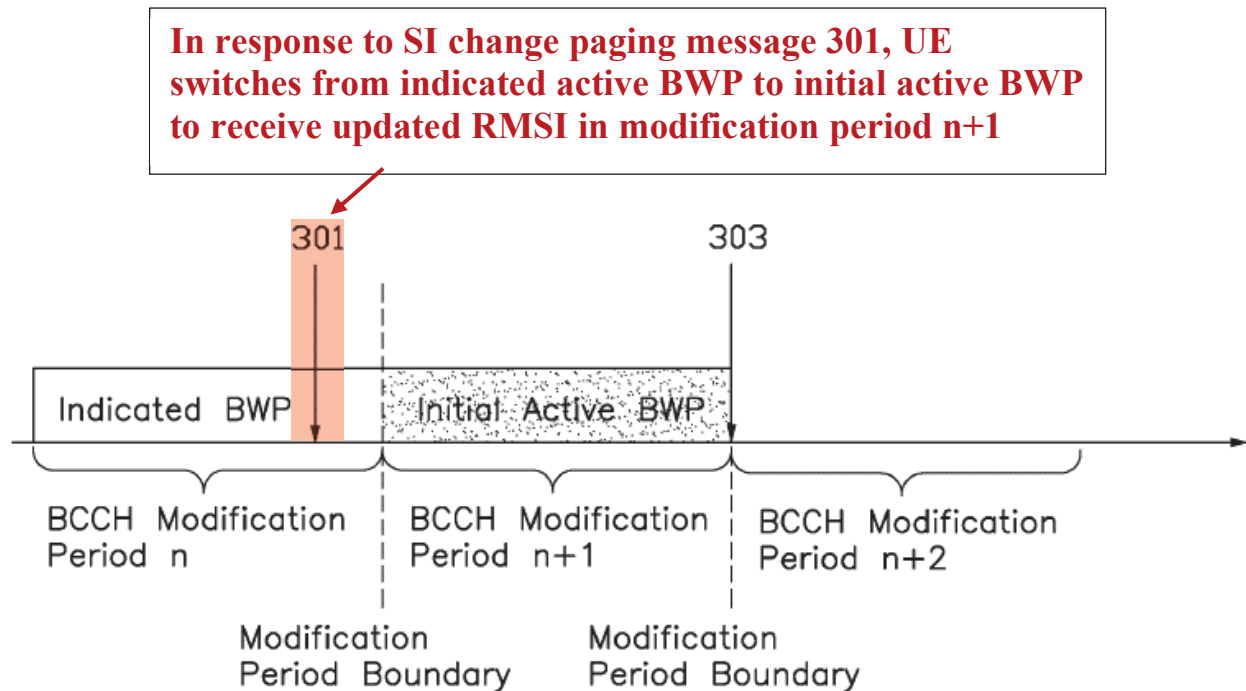
When the NW sends to a Connected_UE a system information (SI) change indication that *notifies of system information change, the Connected_UE may have to switch from the currently active BWP to the initial active BWP* for accessing the RMSI and updating to the changed SI if there is no SI broadcasting on the currently active BWP.

'238 patent, 1:35-41. However, the limitation added in the last claim amendment before allowance—“*in response to receiving the SI change indication, switching from the currently active BWP to an initial active BWP for an SI update*”—is this exact same functionality quoted above and described in the Background section as already being known to POSITAs. '238 patent, 1:35-41, 12:49-51; '238 prosecution history, 163, 187. The prior art discussed below confirms that this technique was already known. Liao, 7:41-53, 8:50-53; Jeon, ¶¶0290, 0297, 0299.

51. Further, the '238 patent's background section incorrectly suggests it was only known to use a “single scheduled downlink control information (DCI)” for “switching one active BWP to another.” '238 patent, 1:31-32. Again, the prior art confirms it was known for a UE to switch BWPs upon receiving a broadcasted SI update paging message (as opposed to a scheduled DCI). Liao, 7:41-53.

52. The '238 patent also describes receiving the updated RMSI “during a next modification period” followed by “receiv[ing] the required changed SIBs

[system information blocks].” ’238 patent, 2:7-9, 2:13. For instance, Fig.3 below illustrates a UE switching from an active BWP to the initial BWP for modification period $n+1$, to get updated SIBs, after receiving an SI change indication paging message 301 in modification period n . ’238 patent, Fig.3, 6:17-34.



’238 patent, Fig. 3 (annotated).

53. However, these concepts of using modification periods to demarcate SI updates and using a paging message for the SI update notification were known and used in the prior generation 4G (LTE) network. OPPO, 1 (“NR can take the modification period concept in LTE as the baseline for NR SI change. ... In LTE [] Paging message is used to notify the [] UEs in RRC_CONNECTED about the system information change.”).

VII. PROSECUTION HISTORY OF THE '238 PATENT

54. The '238 patent was filed in the U.S. on Nov. 15, 2018 and claims priority to a provisional application filed on Nov. 15, 2017. The prior art relied upon herein pre-dates this date.

55. The Patent Office issued a single office action rejecting as obvious the independent claims. '238 prosecution history, 197-208. Applicant then amended the independent claims to add the underlined language: "*receiving a [SI] change indication ... in response to receiving the SI change indication, switching from the currently active BWP to an initial active BWP for an SI update.*" '238 prosecution history, 187. In response to this amendment, the Patent Office issued a notice of allowance and the '238 patent issued on August 11, 2020. '238 prosecution history, 163, 137.

VIII. CLAIM CONSTRUCTION

56. It is my understanding that to properly evaluate the '238 patent, the terms of the claims must first be interpreted. It is my understanding that for the purposes of this *inter partes* review, the claims are to be construed under the so-called *Phillips* standard, under which claim terms are given their ordinary and customary meaning as would be understood by one of ordinary skill in the art in light of the specification and prosecution history, unless the inventor has set forth a special meaning for a term. For the purposes of my analysis below, I believe the

terms of the challenged claims should be given their plain and ordinary meaning, and no terms require specific construction.

IX. IDENTIFICATION OF HOW THE CLAIMS ARE UNPATENTABLE

57. I have been asked to provide my opinion as to whether the Challenged Claims of the '238 patent would have been obvious in view of the prior art. The discussion below provides a detailed analysis of how the prior art references identified below teach the limitations of the Challenged Claims of the '238 patent.

58. As part of my analysis, I have considered the scope and content of the prior art and any differences between the alleged invention and the prior art. I describe in detail below the scope and content of the prior art, as well as differences between the alleged invention and the prior art, on an element-by-element basis for each Challenged Claims of the '238 patent.

59. As described in detail below, the alleged invention of the Challenged Claims would have been obvious in view of the teachings of the identified prior art references as well as the knowledge of a POSITA.

D. Ground 1: Claims 1-2, 4-5, 11-12, and 14-15 are obvious under 35 U.S.C. § 103 over ITRI in view of Liao and Jeon

1. Summary of ITRI

60. ITRI describes “SI change notification” in the context of 3GPP’s 5G working group meetings. ITRI, 1-2; Bishop Declaration, ¶¶43-52.

61. ITRI teaches that, “[u]pon system information change, the change

could be notified from gNB to UE (e.g., by paging message).” ITRI, p.2. In response to receiving the “SI change notification” paging message, the “UE acquires the latest SIB1 from gNB according to the SIB1 scheduling information.” ITRI, 2. SIB1 is included within the RMSI, and the UE can receive “RMSI scheduling information” such as the “[t]ime/frequency resource configuration” of where RMSI is scheduled. ITRI, 1.

62. By reading SIB1 within RMSI, “the UE can identify the changed SIBs and acquire the updated SIBs accordingly.” ITRI, 2. The RMSI also includes a master information block (MIB), which has the scheduling information for these SIBs (other than SIB1). ITRI, 2.

63. Fig.1 below illustrates a UE receiving “SI change notification in a modification period and acquir[ing] the updated SIB in the next modification period.” ITRI, Fig.1, 2.

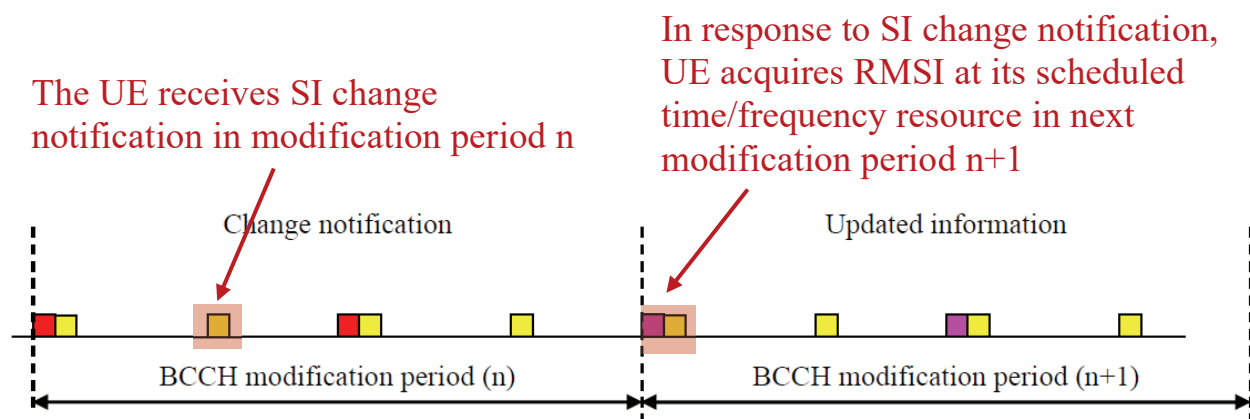


Figure 1. Change of system Information

ITRI, Fig.1 (annotated).

2. Summary of Jeon

64. Jeon teaches methods for 5G “paging control for a system information update.” Jeon, ¶0297.

65. Jeon teaches configuring “an initial active DL BWP for a transmission of RMSI.” Jeon, ¶0276. In more detail, Jeon explains that one “configured DL bandwidth parts for a PCell may comprise a CORESET with a CSS [common search space] type for RMSI.” Jeon, ¶0297. Here, a “CORESET” refers to control signaling resources carried by the BWP; and a “search space” refers to the time and frequency portion of the BWP that is monitored for potential transmissions from the base station. See Draft Minutes RAN1#90b, 67-69; Jeon, ¶¶0271, 0286, 0290. Thus, Jeon describes configuring an initial active BWP with a search space for carrying RMSI. Jeon, ¶¶0276, 0290.

66. Jeon further describes that, in another active BWP, a different search space called a “[g]roup common search space (GCSS)” can be used “as an alternative to CSS for certain information.” Jeon, ¶0290. For instance, “paging control may be transmitted on GCSS.” Jeon, ¶0290. As an example of “paging control,” Jeon describes “paging control for system information update.” Jeon, ¶0297.

67. Therefore, Jeon teaches an active BWP carrying system information update paging messages, which the UE can monitor instead of monitoring a search

space in the initial active BWP for such paging messages. Jeon, ¶¶0276, 0290, 0297. Indeed, Jeon states that a UE “may monitor GCSS” in an active BWP, which carries SI update pages, “instead of switching to the BWP containing the CSS for such information”—that is, instead of switching to the initial active BWP for SI update pages or RMSI itself. Jeon, ¶0290. A POSITA would have understood that Jeon thus describes a UE monitoring for SI update pages in a search space of an active BWP, instead of monitoring for such pages or the updated RMSI itself in a search space of the initial active BWP.

68. Jeon further teaches that a UE can “switch a BWP” to receive “a control channel for RMSI” on the “initial DL BWP”:

[A]n initial DL BWP may comprise a control channel for RMSI, OSI, and/or paging. The wireless device may switch a BWP to monitor such a control channel.

Jeon, ¶0299. A POSITA thus would have understood Jeon to describe a UE in an active BWP to switch to the initial BWP in order to receive RMSI (Jeon, ¶¶0276, 0299). A POSITA also would have recognized that the switch to the initial active “for RMSI” (Jeon, ¶0299) would be in response to an SI update paging message (Jeon, ¶¶00290, 297).

69. To summarize, Jeon describes configuring: 1) a currently active BWP with a search space carrying paging control for a system information update, 2) an initial active BWP with a search space carrying RMSI, and 3) a UE switching

BWPs to acquire RMSI on the initial BWP. Jeon, ¶¶0276, 0290, 0297, 0299. This configuration described in Jeon, with RMSI only carried in the initial active BWP, was well known in the art. Jeon, ¶¶0290, 0297, 0299; Huawei, Fig.1. For instance, Huawei, which was also presented at the 5G working group meetings, illustrates a configuration where RMSI is only located in the first active BWP (BWP1), which does not overlap with the other active BWPs (BWP2 or BWP3). Huawei, Fig.1.

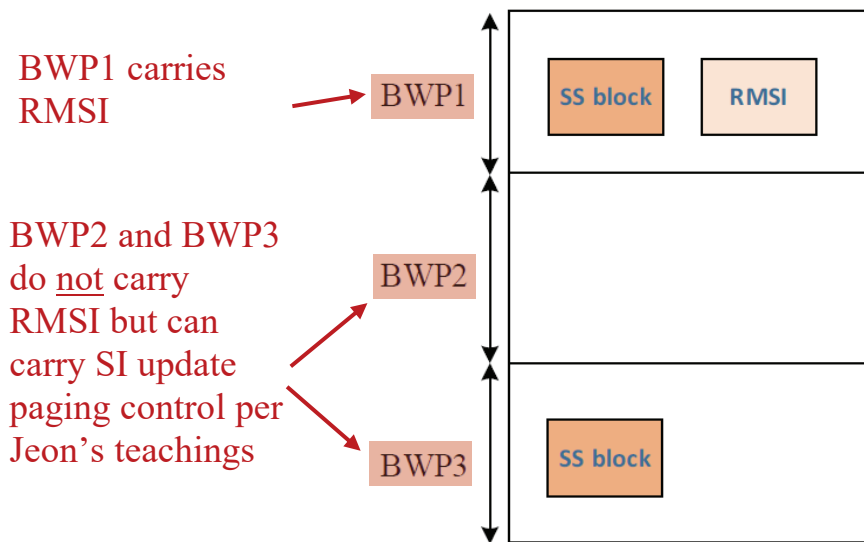


Figure 1 Three types of bandwidth part

Huawei, Fig.1 (annotated to include Jeon, ¶¶0290, 0297, 0376).

3. Reasons to Combine ITRI with Jeon

70. For the reasons set forth below, a POSITA would have been motivated to combine the teachings of ITRI with Jeon. In particular, before the priority date of the '238 patent, it would have been obvious, beneficial, and

predictable to utilize Jeon's teachings regarding multiple BWPs in combination with the system of ITRI. In the resulting combination, ITRI's system for obtaining updated RMSI in the next modification period in response to an SI update paging message would include Jeon's teachings regarding SI updates using multiple BWPs. A UE in ITRI's system obtains updated RMSI in response to a broadcasted SI update paging message; and, as taught by Jeon, the UE receives the SI update paging message in a currently active BWP and switches to the initial active BWP to obtain RMSI. ITRI, 1-2; Jeon, ¶¶0276, 0290, 0297, 0299.

71. As an initial matter, one of ordinary skill in the art when considering the teachings of ITRI would have naturally considered the teachings of Jeon, as Jeon is also analogous prior art pertaining to the same field of endeavor as both ITRI and the '238 patent, namely, cellular telecommunications. See ITRI, 1; Jeon, Abstract. Specifically, both references, like the '238 patent, describe SI acquisition in the context of 5G. ITRI, 2; Jeon, ¶0297. ITRI and Jeon are also pertinent to the particular problem of the '238 patent, such as SI acquisition procedures to reduce network load in 5G. ITRI, 1-2; Jeon, ¶¶0290, 0297, 0299.

72. One of ordinary skill in the art would have been specifically motivated to incorporate Jeon's teachings regarding BWPs into the system of ITRI. ITRI describes a temporal sequence of messages for updating system information in 5G systems; however, ITRI does not explicitly address the aspect that there are

multiple BWPs in 5G networks. A POSITA would have been motivated to supplement ITRI's teachings with compatible teachings regarding system information updates and multiple BWPs, such as in Jeon. See, generally, ITRI, Jeon.

73. In more detail, ITRI describes SI updates in the context of 5G, where RMSI (i.e., SIB1) is scheduled in a particular time/frequency resource. ITRI, 1. Upon receiving an "SI change notification" via "paging message," where "the notification is not SIB-specific" (i.e., broadcast), the UE acquires the RMSI/SIB1 "according to the SIB1 scheduling information carried in MIB." ITRI, 2. However, a well-known aspect of 5G systems is not discussed in ITRI: bandwidth parts (BWPs). Jeon, ¶0376; Draft Minutes RAN1#90b, 68.

74. One of ordinary skill in the art would have been specifically motivated to incorporate Jeon's or similar techniques into ITRI because doing so would thereby address this well-known aspect of 5G systems: configuring a UE for multiple BWPs. While ITRI does not explicitly discuss BWPs, at that time in late 2017, it was already established by the 5G working group that the first publicly accessible version of the upcoming 5G system would support multiple BWPs. Draft Minutes RAN1#90b, 88. Further, the 5G working group agreed that the initial BWP would, by definition, be the frequency-band location of RMSI. Draft Minutes RAN1#90b, 68.

75. Configuring UEs and the network for multiple BWPs, with RMSI being carried only in the initial BWP, as taught by Jeon, was already well known in the art. Jeon, ¶¶0290, 0297, 0299; Huawei, Fig.1. For instance, as discussed above, the Huawei reference was also presented at the 5G working group meetings and teaches RMSI is carried in only one of three BWPs. Huawei, Fig.1.

76. In light of ITRI omitting details about this known aspect of 5G—i.e., multiple BWPs—a POSITA would have looked to augment ITRI's system for SI update in 5G with a known technique for dealing with multiple BWPs. Jeon provides that technique. Jeon's technique provides a bandwidth-efficient BWP configuration (i.e., a currently active BWP carrying SI update pages and an initial active BWP carrying RMSI) that can be used for carrying out ITRI's technique (i.e., obtaining RMSI, at the frequency band identified in MIB, response to a broadcasted SI update page). ITRI, 1-2; Jeon, ¶¶0290, 0297.

77. Therefore, it would have been obvious to make this combination because doing so allows ITRI's technique to be applied to a network and UE configured for multiple BWPs, as was already known to be a feature of the 5G network described by ITRI. Liao, 7:41-53, 8:50-53; Huawei, Fig.1; Draft Minutes RAN1#90b, 68. In other words, POSITAs understood that ITRI was presented to 5G working group meetings, where it was already decided to configure a UE with multiple BWPs. Jeon, ¶¶0290, 0297, 0299; Draft Minutes RAN1#90b, 68. It was

thus obvious to a POSITA that, when a UE obtains changed RMSI in response to a paging notification, as taught by ITRI—the UE may receive the SI update page in an active BWP and then switch to the initial BWP for the RMSI, as taught by Jeon. ITRI, 1-2; Jeon, ¶¶0276, 0290, 0297, 0299.

78. A POSITA also would have been motivated to integrate Jeon's technique into ITRI's system because of the compatibility and similarity of their teachings. Each reference describes a 5G UE obtaining RMSI from its scheduled frequency resource as well as an SI update paging notification. ITRI, 1-2; Jeon, ¶¶0290, 0297. In one example implementation of this combination, a POSITA would have found it obvious to modify ITRI's UE such that it switches BWPs in response to receiving the SI change paging notification, per Jeon. ITRI, Fig.1; Jeon, ¶¶0290, 0297.

79. A POSITA would have found it particularly advantageous to include Jeon's teaching in ITRI because, while ITRI teaches time-domain aspects of SI update, Jeon provides frequency-domain aspects. Specifically, ITRI's system describes a UE's timing for obtaining RMSI in response to an SI change paging notification—i.e., in the next modification period $n+1$. ITRI, 1-2. Meanwhile, Jeon describes the frequency-space configuration for SI updates—e.g., an initial BWP carrying RMSI and an active BWP carrying SI update paging messages, so that the UE does not need to monitor the initial BWP for such pages or the RMSI itself.

Jeon, ¶¶0276, 0290, 0297.

80. A POSITA would have been motivated to make this combination because it was well known that the network may advantageously avoid transmitting RMSI in all possible BWPs, and send paging messages in active BWPs instead, in order to save downlink resources. See, e.g., Jeon, ¶0297. For instance, it was known to be beneficial if the UE could instead switch BWPs to obtain RMSI only when necessary, such as in response to an SI change or update. See, e.g., Jeon, ¶0297, ¶290 (“[P]aging control may be transmitted on GCSS. The wireless device may monitor GCSS, for example, instead of switching to the BWP containing the CSS [and RMSI] for such information.”); Deenoo, ¶0173 (“A [UE] (e.g., in connected state) may monitor a paging channel (e.g., only) for system information update[.]”).

81. It was similarly known to be advantageous that “BWP switching is generally triggered when there is a data traffic which should be transmitted via other BWP not the current BWP.” Samsung, 3. Indeed, it was known that RMSI should be transmitted on an initial active BWP as opposed to all active BWPs. See Draft Minutes RAN1#90b, 68; Huawei, Fig.1. It thus would have been obvious for a UE in ITRI’s system to switch BWPs in response to a paging message indicating an RMSI update. See Liao, 7:41-53.

82. In other words, this combination would have been predictable and

advantageous because the UE's active BWP advantageously only transmits a paging notification that the RMSI has been updated. Jeon, ¶0290. This is advantageous compared to other alternatives such as repeatedly transmitting the RMSI on each and every active BWP, which would consume the network's downlink transmission resources. See Huawei, 1-2. Further, the UE can advantageously just monitor for SI update pages "instead of switching to the BWP containing the CSS for such information" such as the updated RMSI itself; this allows the UE to avoid unnecessarily switching to the initial active BWP for RMSI, and also avoid reacquiring and processing the RMSI, in the situations when an updated RMSI is not needed (i.e., no SI update paging message received). Jeon, ¶¶0242, 0290.

83. A POSITA also would have made this combination because Jeon's teachings beneficially allow the UE to always locate and obtain RMSI by switching to the initial active BWP, which also advantageously allows the system to treat this BWP as a "default BWP." Jeon, ¶0275. Jeon explains, "a wireless device (e.g., RRC IDLE wireless device) may fall back to an initial BWP" when necessary or by default, as "[a] default BWP on a PCell may be an initial active DL BWP for a transmission of RMSI." Jeon, ¶¶0275-0276.

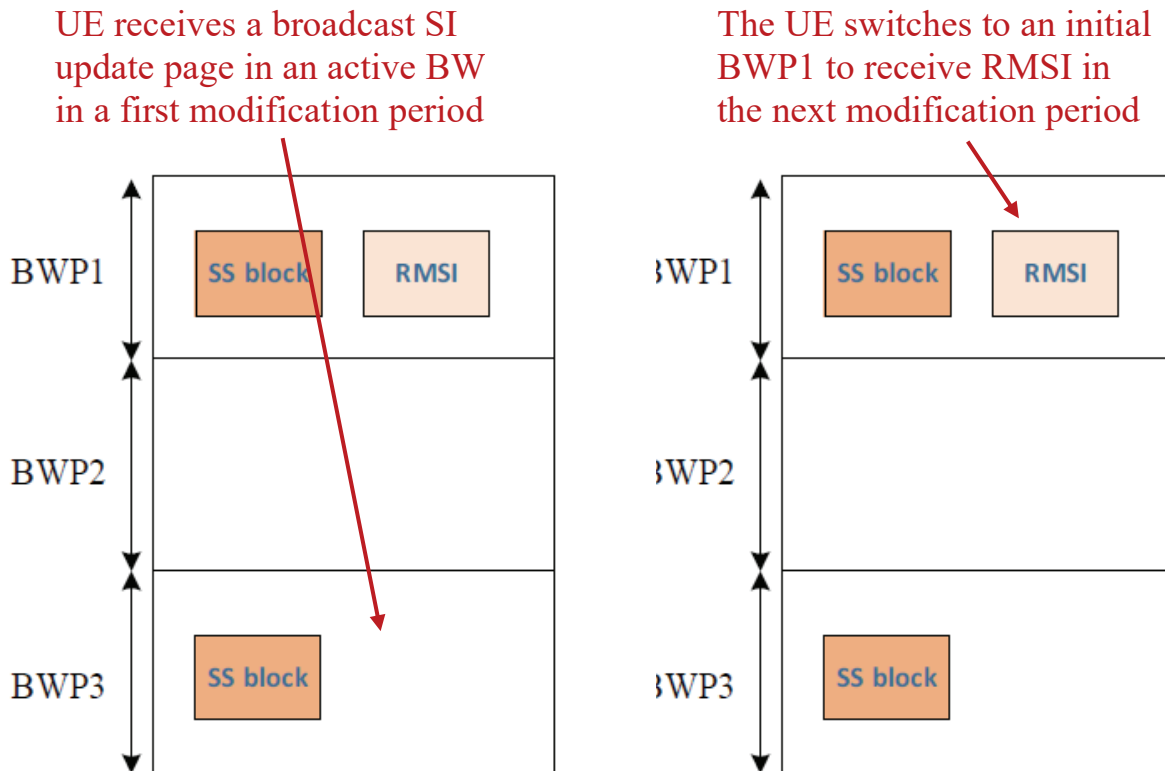
84. Not only would utilizing Jeon's multiple BWP configuration in ITRI's system have been advantageous, but a POSITA would have also found the

combination predictable and would have had a reasonable expectation of success, for several reasons. For instance, this combination was described in other references as well. Yi (Yi) describes UE procedures for multiple BWPs, which Yi also refers to as “subbands.” Yi, ¶¶0113. Similar to Jeon, Yi explains that, where the system does not periodically transmit SIB and instead transmits a “system update indication,” for “SIB transmission, a UE may retune to anchor subband.” Yi, ¶0284. That is, Yi describes that a UE may receive an SI update notification and, in response, switch to the anchor BWP (i.e., initial active BWP) to obtain the SIBs (i.e., at least RMSI). Yi, ¶0284.

85. In sum, Jeon’s technique provides a BWP configuration (i.e., an active BWP for SI update pages and an initial BWP for RMSI) that can be implemented in ITRI’s system—which includes a UE receiving an SI update notification in one modification period and the updated RMSI/SIB in the next modification period. ITRI, 1-2. Therefore, a POSITA would have been motivated to incorporate Jeon’s teachings into ITRI because it provides further implementation details regarding SI update in the context of multiple BWPs.

86. To illustrate, Fig.1 of Huawei has been duplicated and annotated below to illustrate the combination of ITRI with Jeon. ITRI, 1-2; Jeon, ¶¶0290, 297; Huawei, Fig.1. As illustrated, in the first modification period (left), the UE receives in an active BWP a paging message indicating an SI update is available;

then, the UE switches to the initial BWP to receive the updated RMSI in the next modification period (right). ITRI, 1-2; Jeon, ¶¶0290, 297; Huawei, Fig.1.



uawei, Fig.1 (duplicated and annotated to include teachings of ITRI and Jeon).

87. A POSITA also would have found the combination predictable and had an expectation of success because it was already well known in the art for RMSI to be carried only in the initial active BWP while other active BWPs carry SI update paging messages. Huawei, Fig.1; Qualcomm, Fig.4; MediaTek, 6. For instance, MediaTek (MediaTek) describes a similar implementation. In MediaTek, “one of configured DL bandwidth parts includes [a search space] for RMSI,” while

“each configured DL bandwidth part includes [a search space] for ... paging control for system information update[.]” MediaTek, 6. Thus, like Jeon, MediaTek describes a BWP configuration with SI update pages received on a currently active BWP and RMSI received on another (i.e., initial active) BWP. See MediaTek, 6; Draft Minutes RAN1#90b, 68.

88. A POSITA thus would have also found the combination predictable and would have had a reasonable expectation of success, as the combination does not change the intended functionality of either ITRI’s or Jeon’s technique. For instance, a POSITA would have expected success as ITRI’s technique was specifically intended to be implemented in a 5G system, which was known to support multiple BWPs, as described by Jeon. ITRI, 1-2; Jeon, ¶0290.

89. Accordingly, a POSITA would have found it obvious to apply Jeon’s teachings to ITRI because the combination merely amounts to implementing a known 5G BWP configuration technique to the 5G system of ITRI.

90. To the extent Jeon does not explicitly state that the UE switches BWPs after receiving an SI update paging message, it would have been obvious to a POSITA in view of Jeon, and Liao explicitly provides these obvious details.

4. Summary of Liao

91. Liao describes “system information update” in the context of 5G. Liao, 1:62-67, 7:48-52. Liao describes how “the UE can switch among configured

BWPs” including “for system information update.” Liao, 7:41-42, 7:51-52. For instance, if “the current active BWP for the UE does not include a CORESET with CSS, the UE can switch its active BWP to the one including a CORESET with CSS ... for the monitoring of broadcast message, such as SI.” Liao, 8:49-53.

92. In particular, Liao teaches that a UE can switch BWPs based on a variety of signaling techniques: “BWP switch can be based two or more combined methods including a higher-layer signaling, such as the RRC-layer signaling or a MAC CE; a physical-layer signaling, such as the DL control information (DCI).” Liao, 7:43-47. Also, the BWP switch signaling can be a “broadcast and/or multi-cast message includ[ing] ... paging control for system information update.” Liao, 7:44-51.

5. Reasons to Combine ITRI and Jeon with Liao

93. For the reasons set forth below, a POSITA would have been motivated to combine the teachings of ITRI and Jeon with Liao. In particular, before the priority date of the '238 patent, it would have been obvious, beneficial, and predictable to utilize Liao's teachings in combination with the ITRI-Jeon system. For example, Liao teaches a UE switching BWPs in response to an SI update page; this allows a UE to obtain the updated RMSI in its scheduled time/frequency resource, in the next modification period, as taught by ITRI. ITRI, 2; Liao, 7:41-53. Further, this allows the UE to switch from an active BWP

carrying SI update paging messages to the initial BWP carrying RMSI, as taught by Jeon. See Jeon, ¶¶0276, 0290, 0297. Liao thereby provides a simple, predictable, and compatible technique for when the updated RMSI is carried in a different BWP than the active BWP: in response to receiving the SI update page, the UE switches to the initial BWP to obtain the updated RMSI. Liao, 7:41-53.

94. As an initial matter, one of ordinary skill in the art when considering the teachings of ITRI and Jeon would have naturally considered the teachings of Liao as they are all analogous prior art to and pertain to the same field of endeavor as the '238 patent, namely, cellular telecommunications. See ITRI, 1; Liao, Abstract. Specifically, all three references, like the '238 patent, describe SI acquisition in the context of 5G. ITRI, 2; Liao, 1:62-67, 7:48-52; Jeon, ¶0290. Liao is also pertinent to the particular problem of the '238 patent, such as SI acquisition procedures to reduce network load in 5G. ITRI, 1; Liao, Abstract.

95. In more detail, ITRI and Jeon describe a system that a POSITA would have looked to Liao for compatible implementation details. As discussed above, ITRI describes SI updates in the context of 5G. ITRI, 1. And Jeon describes a well-known BWP configuration for 5G, with SI update paging on a currently active BWP and RMSI on an initial active BWP. Jeon, ¶¶0276, 0290, 0297; Draft Minutes RAN1#90b, 68. One of ordinary skill in the art would have been specifically motivated to incorporate Liao's or similar techniques into the system

of ITRI and Jeon because doing so would thereby address this well-known aspect of SI update paging in the context of multiple BWPs: the UE switches to the initial BWP in response to a broadcasted SI update paging message. Liao, 7:41-53; Jeon, ¶¶0290, 0297; Huawei, Fig.1.

96. In more detail, Jeon describes configuring an active BWP with paging control for a system information update and an initial active BWP carrying RMSI, as discussed above at Section IX.C.2. Jeon, ¶¶0290, 0297. In Jeon, because the RMSI is located on a fixed BWP that does not change, a POSITA would have found it obvious that a connected-mode UE receiving the SI update indicator on the currently active BWP triggers a switch to the initial active BWP to get the updated RMSI. See Jeon, ¶0290.

97. However, to the extent Jeon does not explicitly state that the UE switches BWPs after receiving an SI update paging message, Liao provides these obvious details. Liao, 7:41-53; Jeon, ¶¶0290, 0297. A POSITA thus would have looked to augment the ITRI-Jeon system for SI update in 5G with a known technique for BWP switching: a broadcasted paging message indicating an SI update is available. Liao provides that technique. Specifically, Liao teaches that various types of signaling can be used to instruct a UE to switch BWPs (Liao, 7:41-47); and as one advantageous example, the UE can receive a broadcast including a system information update paging message (Liao, 7:48-51).

98. Therefore, it would have been obvious to make this combination because Liao merely provides explicit details of UE behavior in the system of ITRI and Jeon. Liao, 7:41-53. It was thus obvious to a POSITA that, when a UE obtains changed RMSI in response to a paging notification as taught by ITRI—and the active BWP includes the page whereas the initial BWP carries RMSI, per Jeon—the UE may switch BWPs to obtain the RMSI in response to the SI change paging message, as taught by Liao. ITRI, 1-2; Liao, 7:41-53; Jeon, ¶0290, 0297.

99. A POSITA also would have been motivated to integrate Liao's technique into the system of ITRI and Jeon because of the compatibility and similarity of their teachings. All three references describe a 5G UE obtaining RMSI from its scheduled frequency resource in response to a SI update paging notification. ITRI, 1-2; Liao, 7:41-53; Jeon, ¶¶0276, 0290, 0297. In one example implementation of this combination, a POSITA would have found it obvious to modify a UE in the system of ITRI, such that the UE switches BWPs in response to receiving the broadcasted SI change paging notification, per Jeon and Liao. ITRI, Fig.1; Liao, 7:41-53.

100. A POSITA would have found it particularly advantageous to include Liao's teaching in combination with ITRI because, while ITRI teaches time-domain aspects of SI update, Liao provides frequency-domain (i.e. bandwidth) aspects. Specifically, ITRI's system describes a UE's timing for obtaining RMSI in

response to an SI change paging notification—i.e., in the next modification period. ITRI, 1-2. Meanwhile, Liao describes the UE's frequency response to the same SI change paging notification—i.e., switch to the initial BWP. Liao, 7:41-53.

101. Indeed, this combination would have been predictable and advantageous because, as discussed above at Section IX.C.3, the UE's active BWP advantageously only transmits a paging notification that the RMSI has been updated.

102. Not only would utilizing Liao's BWP switching technique in ITRI-Jeon's system have been advantageous, but a POSITA would have also found the combination predictable and would have had a reasonable expectation of success, for several reasons. For instance, this combination was described in other references as well. As described above at Section IX.C.2, the Yi reference (Yi), like Liao, explains that in response to receiving "system update indication," for "SIB transmission, a UE may retune to anchor subband," i.e., initial BWP, to obtain the SIBs. Yi, ¶0284.

103. The combination also would have been predictable with an expectation of success because the combination does not change the intended functionality of any of ITRI's UE performing an SI update procedure, Jeon's BWP configuration, or Liao's BWP switching technique. In fact, Liao's technique was specifically intended to be implemented in a 5G UE (such as ITRI and Jeon's 5G

UE). See ITRI, 1; Liao, 1:53-67; Jeon, Abstract; see also Yi, ¶0284. Furthermore, the resulting combination would have been obvious, as the UE switching BWPs automatically or autonomously in response to the SI update paging message was one of only two options; indeed, the other option, where the UE waits for additional signaling to cause a BWP switch, would consume more network and UE resources. Cf. '238 patent, 1:30-32.

104. Accordingly, a POSITA would have found it obvious to apply Liao's teachings to ITRI-Jeon's system because the combination merely amounts to applying a known BWP switching technique to a RMSI update technique and BWP configuration ready for improvement.

6. Claim 1

[1.0] *A method for a user equipment (UE) of a connected state, the method comprising:*

105. First, ITRI "discuss[es] the notification of SI change." ITRI, 1. ITRI describes that "**upon system information change, the change could be notified from gNB to UE** (e.g., by paging message)" ("*[a] method for a [UE]*"). ITRI, 2.

106. To the extent ITRI does not explicitly teach "*a user equipment (UE) of a connected state,*" it would have been obvious to a POSITA that ITRI's teachings apply to "*connected*" UEs (e.g., UEs in RRC_connected mode). Indeed, this limitation was well known to POSITAs as taught by Jeon, for example. Jeon, ¶0276.

107. Second, like ITRI, Jeon describes “paging control for a system information update.” Jeon, ¶0297. Jeon further describes that a UE may be in an “active BWP for a user after a wireless device becomes **RRC connected**” (“*a [UE] of a connected state*”). Jeon, ¶0276. A POSITA would have found it obvious to combine the teachings of ITRI and Jeon at least for the reasons described above at Section IX.C.5. Indeed, it was well known in the art that a “Paging message is used to notify the [] UEs in RRC_CONNECTED about the system information change.” Oppo, 1; Deenoo, ¶0173.

108. Thus, ITRI and Jeon render obvious the preamble.

[1.1] *receiving a system information (SI) change indication broadcasted by a paging via a currently active bandwidth part (BWP) during a modification period;*

109. First, ITRI teaches that, “[u]pon system information change, the change could be notified from gNB to UE (e.g., by paging message).” ITRI, 1. ITRI explains that the “UE may receive multiple SI change notification in a modification period and acquire the updated SIB in the next modification period.” ITRI, 2. ITRI illustrates a UE receiving an SI change notification in a modification period (called “BCCH modification period (n)”) in Fig.1 below. ITRI, Fig.1.

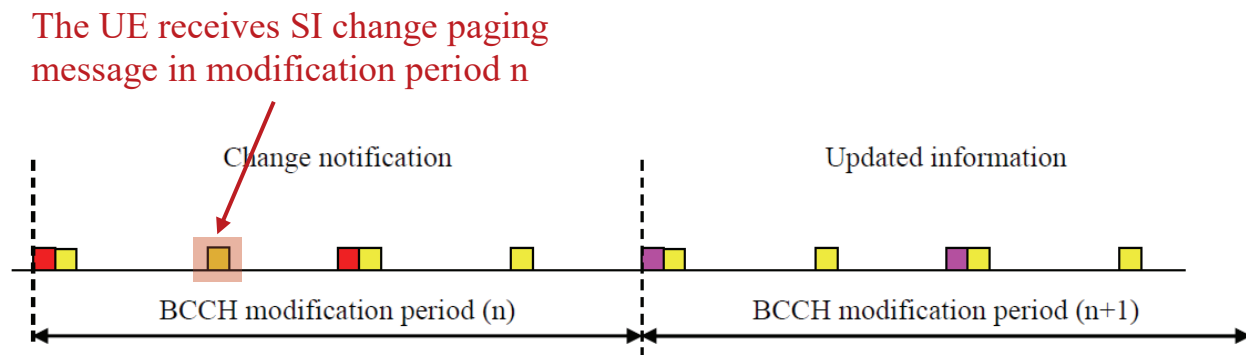


Figure 1. Change of system Information

ITRI, Fig.1 (annotated).

110. Therefore, ITRI teaches “receiving a system information (SI) change indication [] by a paging ... during a modification period.”

111. To the extent ITRI does not explicitly teach that the SI change page is “broadcasted” in an “active bandwidth part (BWP),” it would have been obvious to a POSITA that ITRI’s SI “paging message” may be broadcasted in an active BWP. Indeed, these aspects were well known to POSITAs as taught by Liao and Jeon, for example. Liao, 7:44-51; Jeon, ¶¶0290, 0297.

112. Second, Liao teaches a UE receiving a “**broadcast** and/or multi-cast message includ[ing] ... **paging control for system information update.**” Liao, 7:44-51. Therefore, Liao explains that an “SI change indication,” as described in ITRI, can be “broadcasted by a paging.” ITRI, 2; Liao, 7:44-51.

113. Third, Jeon—like ITRI and Liao—describes “paging control for a system information update” in 5G. Jeon, ¶0297. Jeon teaches a BWP configuration

technique including “an initial active DL BWP for a transmission of RMSI” and **“an active BWP for a user after a wireless device becomes RRC connected.”**

Jeon, ¶0276. For instance, in an active BWP, a “base station may configure GCSS” and “paging control may be transmitted on GCSS.” Jeon, ¶0290.

114. A POSITA would have found it obvious to combine the teachings of ITRI and Jeon at least for the reasons described above at Section IX.C.5. In the resulting combination, the SI change page sent in a modification period, as taught by ITRI, is a broadcasted paging message, as taught by Liao. ITRI, 2; Liao, 7:48-51. This broadcasted paging message can be received by a connected mode UE in an active BWP, per Jeon. Jeon, ¶¶0276, 0290, 0297. Indeed, this combination would have been predictable with an expectation of success because it was also described in other prior art. Oppo, 2-3 (“The change notification for the Minimum SI contained in PDSCH i.e. SIB1 [] should be added in Paging message. ... [N]etwork will send the updated SI after the modification boundary[.]”).

115. Thus, ITRI teaches a UE receiving an SI change notification paging message in a modification period, Liao teaches broadcasting a paging message for SI update, and Jeon teaches receiving the SI update paging message in an active BWP, which together renders obvious “receiving a system information (SI) change indication broadcasted by a paging via a currently active bandwidth part (BWP) during a modification period.”

[1.2] in response to receiving the SI change indication, switching from the currently active BWP to an initial active BWP for an SI update;

116. First, as discussed above at [1.1], ITRI teaches that a UE may receive an “SI change notification” including “by paging message.” ITRI, 1-2. Therefore, ITRI teaches “receiving the SI change indication.”

117. ITRI also describes that, via the MIB, the UEs receive scheduling information indicating the frequency resources of the CORESET (*i.e.*, control resource set) that carries RMSI:

The UE receives RMSI scheduling information, including the time and frequency resources where RMSI is available to UEs

- RMSI scheduling information: [x] bits
 - CORESET(s) information: [x] bits
 - Simplified information of CORESET(s) compared to CORESET(s) information for UE-specific configuration is considered
 - E.g., Time/frequency resource configuration of CORESET(s)

ITRI, 1 (annotated).

118. Using this frequency information for obtaining RMSI (*i.e.*, SIB1), and in response to a “SI change notification ... UE can identify the change of SIB1 upon the notification. The UE acquires the latest SIB1.” ITRI, 2. Therefore, “in response to receiving the SI change indication,” ITRI teaches that the UE will get “an SI update.” ITRI, 2.

119. To the extent ITRI does not provide details regarding “switching ... BWP[s]” (*i.e.*, switching frequencies) for the SI update, such techniques were well

known to a POSITA, as taught by Jeon and Liao.

120. Second, Jeon teaches details on how the initially active BWP and the currently active BWP are utilized to provide SI update paging messages and RMSI. Jeon, ¶¶0290, 0297. For example, Jeon explains that the “initial active DL BWP” is “defined” as the location for RMSI. Jeon, ¶0376 (“An initial active DL BWP may be defined as frequency location and bandwidth of RMSI CORESET and numerology of RMSI.”), ¶0297. Jeon further teaches that a UE may “switch” to the initial active DL BWP to receive RMSI:

[A]n initial DL BWP may comprise a control channel for RMSI, OSI, and/or paging. The wireless device may switch a BWP to monitor such a control channel.

Jeon, ¶0299.

121. In addition, a “base station may configure [a search space] within a BWP” such as a currently active BWP. Jeon, ¶0290. This search space is provided “as an alternative to [the search space carrying RMSI] for certain information.” Jeon, ¶0290. For instance, “**paging control may be transmitted**” on the search space of a currently active BWP. Jeon, ¶0290. One such paging control message that can be sent in the currently active BWP is “**paging control for a system information update.**” Jeon, ¶0297.

122. Therefore, Jeon teaches configuring SI update pages on an active BWP so that the UE does not have to monitor the initial BWP for such pages and

RMSI. See Jeon, ¶¶0290, 0297; Huawei, Fig.1. In view of these teachings, a POSITA would have understood a UE could monitor an active BWP for SI update paging, and upon receiving an SI update page, switch to the initial BWP for RMSI. To the extent Jeon does not explicitly teach a UE switching BWPs specifically in response to a SI update paging message, these details are taught by Liao.-

123. Third, Liao teaches that a UE may switch BWPs based on a variety of signaling techniques: “BWP switch can be based [on] two or more combined methods including a higher-layer signaling, such as the RRC-layer signaling or a MAC CE; a physical-layer signaling, such as the DL control information (DCI).” Liao, 7:43-47. Liao explains that the BWP switch signaling can be a “**broadcast and/or multi-cast message includ[ing] ... paging control for system information update.**” Liao, 7:44-51. Therefore, Liao teaches that a UE switches BWPs in response to a broadcasted SI update paging message (“*in response to receiving the SI change indication, switching from the currently active BWP*”); and Jeon explains that the switch is from a currently active BWP carrying SI updates to the initial active BWP, which is defined as the BWP that carries RMSI. Draft Minutes RAN1#90b, 68; Huawei, Fig.1.

124. Therefore, Jeon and Liao together teach that, in response to an SI update paging message, the UE switches from a currently active BWP to an initial active BWP for the updated RMSI (“*in response to receiving the SI change*

indication, switching from the currently active BWP to an initial active BWP for an SI update"). Liao, 7:41-53; Jeon, ¶¶0276, 0290, 0297. Indeed, Liao explains that if "the UE can switch its active BWP ... for the monitoring of broadcast message, such as SI" if "the current active BWP for the UE does not include" a search space carrying SI such as RMSI. Liao, 8:49-53.

125. A POSITA would have found it obvious to combine the teachings of Jeon and Liao with ITRI's 5G system "*for an SI update*" at least for the reasons described at Sections IX.C.3 and IX.C.5. For instance, the resulting combination beneficially allows the UE to monitor pages on the currently active BWP "instead of switching to the BWP containing" RMSI. Jeon, ¶0290. Indeed, combining Liao's teachings with ITRI-Jeon would have been obvious because Jeon already explains that a UE can "switch a BWP" to receive "a control channel for RMSI." Jeon, ¶0299.

126. Thus, ITRI teaches a UE receiving an SI update notification via paging message and frequency scheduling information for RMSI. Jeon teaches configuring a currently active BWP carrying SI update paging, an initial active BWP carrying RMSI, and a UE switching BWPs to obtain RMSI. ITRI, 1-2; Jeon, ¶¶0276, 0290, 0297, 0299. Further, Liao teaches a UE switching BWPs in response to a broadcasted SI update paging message. Liao, 7:41-53. These references describe known techniques for SI update in the context of multiple BWPs and

render obvious “in response to receiving the SI change indication, switching from the currently active BWP to an initial active BWP for an SI update.”

[1.3] receiving remaining minimum SI (RMSI) via the initial active BWP during a next modification period that immediately follows the modification period,

127. ITRI teaches that, in response to a “SI change notification ... The UE acquires the latest SIB1.” ITRI, 2. Fig.1 below illustrates a UE receiving “SI change notification in a modification period and **acquir[ing] the updated SIB in the next modification period.**” ITRI, Fig.1; *see also id.* at 2.

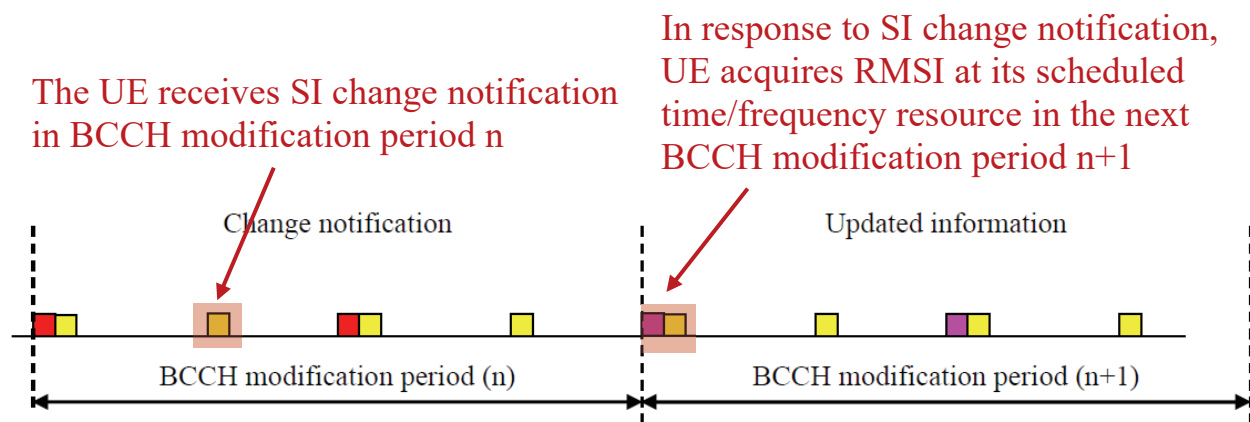


Figure 1. Change of system Information

ITRI, Fig.1 (annotated).

128. ITRI further explains that the UE receives the RMSI/SIB1 according to “RMSI scheduling information” including “frequency resource configuration” of where RMSI is scheduled. ITRI, 1. To the extent ITRI does not provide details regarding in which BWP the RMSI is received in, Jeon teaches it was well known to receive RMSI in the “initial active BWP.”

129. Specifically, as described above at [1.2], Jeon teaches that a UE will “switch” to the initial active DL BWP for RMSI because the initial active DL BWP is “defined” as the BWP that contains RMSI. Jeon, ¶¶299, 0376. Therefore, in view of Jeon’s teachings, a POSITA would have found it obvious that a UE in ITRI’s system would receive the updated SIB1 in an “*initial active BWP*.” It would have been obvious to combine the teachings of Jeon with ITRI’s system at least for the reasons described at Section IX.C.5.

130. Thus, ITRI teaches receiving RMSI in the next modification period following the modification period in which an SI update paging message is received, and Jeon teaches receiving RMSI in an initial active BWP, which render obvious “*receiving remaining minimum SI (RMSI) via the initial active BWP during a next modification period that immediately follows the modification period.*”

[1.4] wherein the RMSI includes information associated with changed system information blocks (SIBs);

131. ITRI teaches that, having received the SIB1 (*i.e.*, “*RMSI*”), the “UE may **check the scheduling information carried in the latest SIB1 for the validity of the other stored SIBs.**” ITRI, 2. Then, “[i]f the scheduling information is different from the stored scheduling information, **the UE can identify the changed SIBs** and acquire the updated SIBs accordingly” ITRI, 2. For example, the SIB1 can include “value tag” information for SIBs, and “[i]f the value tag/area

information associated a SIB is different from the stored one, UE then identifies the changed SIB(s).” ITRI, 2.

132. Thus, ITRI teaches that the SIB1 (*i.e.*, RMSI) includes scheduling information for identifying the changed SIBs, which renders obvious “*wherein the RMSI includes information associated with changed system information blocks (SIBs).*”

[1.5] determining which of the changed SIBs is required to be updated for the UE according to the received RMSI; and

133. As discussed at [1.4], ITRI teaches that the UE checks “scheduling information carried in the latest SIB1.” ITRI, 2. And “[i]f the scheduling information is different from the stored scheduling information, **the UE can identify the changed SIBs and acquire the updated SIBs accordingly.**” ITRI, 2. For example, the SIB1 can indicate for each of the SIBs a “value tag”—which can be a numerical value that changes each time an SIB is updated. ITRI, 2. Then, “[i]f **the value tag/area information associated a SIB is different from the stored one, UE then identifies the changed SIB(s).**” ITRI, 2. ITRI further explains that it was agreed at a 5G working group meeting to broadcast an “index/identifier in minimum SI to **enable the UE to avoid re-acquisition of already stored SI-block(s)/SI messages(s).**” ITRI, 1. ITRI further explains, the “**UE is able to re-acquire only the SIBs which are updated.**” ITRI, 3.

134. Therefore, ITRI teaches “the UE can identify the changed SIBs and

acquire the updated SIBs accordingly”—such that the UE determines that all changed SIBs need to be acquired and then acquires those SIBs. ITRI, 2. ITRI further explains that the “value tag associated with the concerned SIB may help UE to **determine whether or not to re-acquire the update[d] SIB** in the next modification period.” ITRI, 2. A POSITA would thus understand ITRI’s technique to include “*determining which of the changed SIBs is required to be updated.*” ITRI, 2.

135. Indeed, it was well known in the art and obvious to a POSITA that, in both LTE (4G) as well as 5G system discussed in ITRI, each UE can determine which of the changed SIBs require updating based on that UE’s capabilities or services used. Jeon, ¶0162 (“The minimum SI may comprise basic information required for initial access and information for acquiring any other SI broadcast periodically or provisioned on-demand, i.e. scheduling information. The other SI may either be broadcast, or be provisioned in a dedicated manner, either triggered by a network or upon request from a wireless device.”); Oppo, 1 (“**[B]oth types of SI [i.e. Minimum SI and Other SI] require the UE who are interested in the information** getting the notification before the system information really changes”); Agiwal, ¶0009 (describing various SIBs the “UE needs to acquire” in idle, inactive, and connected states).

136. Thus, ITRI teaches the UE identifying which SIB(s) are different

based on value tags and acquiring the updated SIBs, which renders obvious
“determining which of the changed SIBs is required to be updated for the UE according to the received RMSI.”

[1.6] receiving content of the required changed SIBs based on the determination.

137. As discussed above at [1.4] and [1.5], ITRI teaches that, after acquiring the latest SIB1 (RMSI), “the UE can identify the changed SIBs and **acquire the updated SIBs accordingly.**” ITRI, 2. For example, “[i]f the value tag/area information associated [with] a SIB is different from the stored one, **UE then identifies the changed SIB(s) and acquires the latest SIBs** from gNB accordingly.” ITRI, 2. Fig.1 annotated below illustrates the UE receiving the updated SIB1 to determine which updated SIB(s) to acquire, based on value tags, and then receiving the updated SIB(s). ITRI, Fig.1, 2-3.

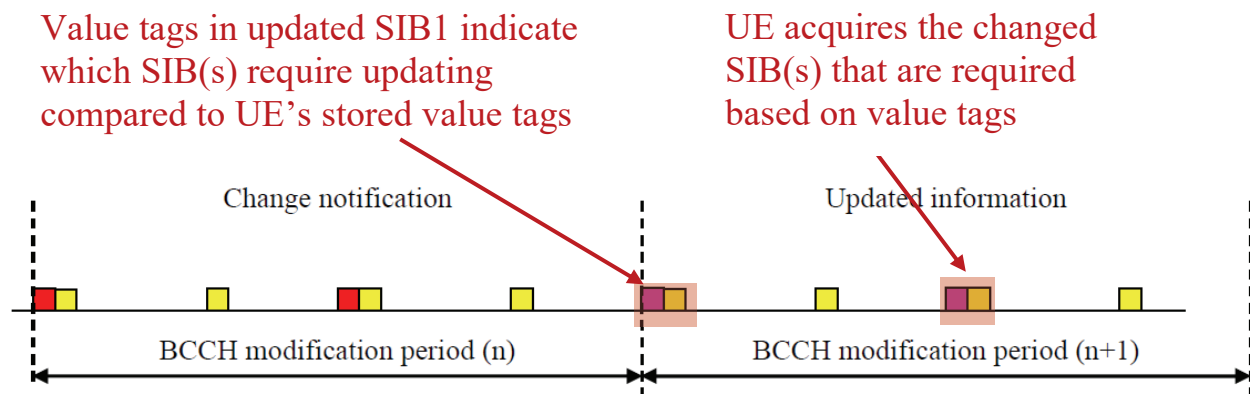


Figure 1. Change of system Information

ITRI, Fig.1 (annotated).

138. Thus, ITRI teaches the UE acquiring updated SIB(s) based on

determining which SIB(s) have changed by comparing value tags in SIB1 to the UE's stored value tags, which renders obvious *"receiving content of the required changed SIBs based on the determination."*

7. Claim 2

[2.0] The method of claim 1, wherein the currently active BWP is switched to the initial active BWP automatically on the end of the modification period.

139. As discussed above at [1.2], ITRI in view of Liao and Jeon teach a UE switching from an active BWP to an initial active BWP to receive an RMSI update in the next modification period. ITRI, 1; Liao, 7:41-53; Jeon, ¶¶0290, 0297. ITRI explains that the "UE may receive multiple SI change notification in a modification period and acquire the updated SIB in the next modification period." ITRI, 2; *see also* ITRI, 3 ("[i]f the notification is not SIB-specific, the UE should acquire the latest SIB1."). ITRI illustrates in Fig.1 below that a UE can receive updated SI "in the next modification period" (i.e., $n+1$). ITRI, 2, Fig.1.

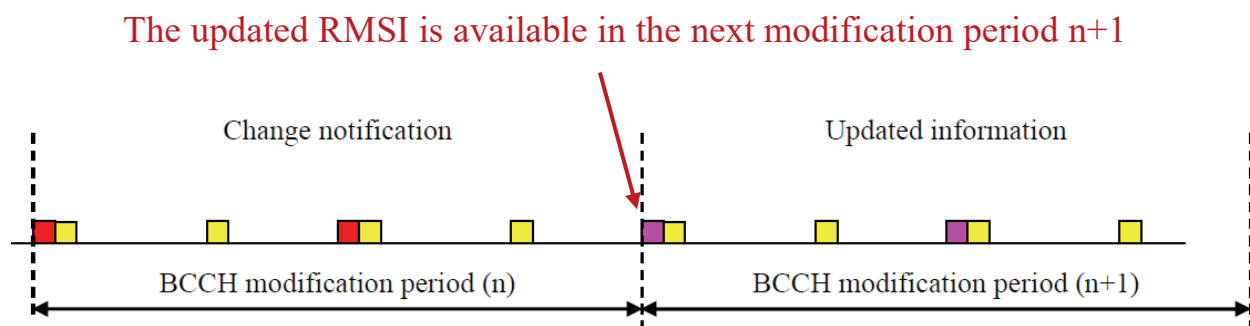


Figure 1. Change of system Information

ITRI, Fig.1 (annotated).

140. To the extent ITRI does not provide details regarding “is switched to the initial active BWPing ... BWP[s]” (i.e., switching frequencies) for the SI update, such techniques were well known to a POSITA, as taught by Jeon and Liao. *See* Liao, 7:41-53, 8:49-53; Jeon, ¶¶0290, 0297, 0276. Therefore, the prior art describes a UE that switches to an initial BWP to obtain updated RMSI in response to an SI update paging message (*see* Liao, 7:41-53; Jeon, ¶¶0290, 0297, 0276), where the updated RMSI is available in the next modification period (ITRI, Fig.1, 2). It thus would have been obvious to a POSITA that, in the system of ITRI in view of Liao and Jeon, the UE would switch to the initial BWP at the end of the current modification period to receive the updated RMSI.

141. This technique would have been obvious because the UE is able to obtain the updated RMSI as soon as it is available: at the beginning of the next modification period. Waiting until the end of the modification period to switch BWPs also would have advantageously allowed the connected UE to continue receiving UE-specific data or control information, using a greater bandwidth, on the currently active BWP. Further, it would have been obvious for the UE to switch to the initial BWP autonomously or “*automatically*” as a UE autonomously switching BWPs was known in the art. Jeon, ¶0293 (describing a UE may “autonomously switch to a default BWP”).

142. Thus, ITRI teaches obtaining updated RMSI in the next modification

period, which in view of Liao's and Jeon's teachings of switching to an initial BWP to obtain updated RMSI in response to an SI update notification, renders obvious "*wherein the currently active BWP is switched to the initial active BWP automatically on the end of the modification period.*"

8. Claim 4

[4.0] *The method of claim 1, wherein the currently active BWP is switched to the initial active BWP in response to receiving downlink control information (DCI).*²

143. As discussed above at [1.2], Liao teaches that a UE may switch BWPs based on a variety of signaling techniques: "BWP switch can be based two or more combined methods including a higher-layer signaling, such as the RRC-layer signaling or a MAC CE; **a physical-layer signaling, such as the DL control information (DCI).**" Liao, 7:43-47.

144. Thus, Jeon teaches a UE that can switch from an active BWP to an initial BWP, and Liao teaches that the switch is in response to downlink control information such as a SI update paging broadcast, which in view of ITRI's system

² The '238 patent specification provides an example where a broadcasted paging message is an example downlink control information (DCI) message. '238 patent, 4:11-15 ("[T]he UE receives indications about SI modifications and/or PWS notifications using Short Message transmitted with P-RNTI over downlink control information (DCI).").

renders obvious “wherein the currently active BWP is switched to the initial active BWP in response to receiving downlink control information (DCI).”

9. Claim 5

[5.0] The method of claim 1, further comprising: completing the SI update of the required changed SIBs within the next modification period in response to receiving the content of the required changed SIBs.

145. As discussed above at [1.6], ITRI teaches “UE may receive multiple SI change notification in a modification period and acquire the updated SIB in the next modification period.” ITRI, 2. For instance, “the UE should acquire the latest SIB1”. ITRI, 1. Using the value tags included in the latest SIB1, “the UE can identify the changed SIBs and acquire the updated SIBs accordingly.” ITRI, 2..

146. Fig.1 annotated below illustrates the UE receiving the updated SIB1 to determine which updated SIB(s) to acquire, based on value tags, and then receiving the updated SIB(s) in the next modification period. ITRI, Fig.1, 2-3.

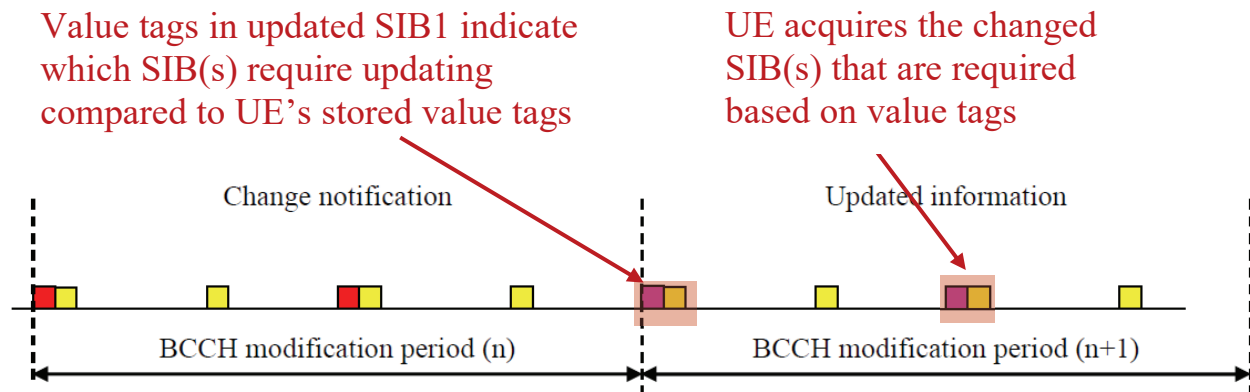


Figure 1. Change of system Information

ITRI, Fig.1 (annotated).

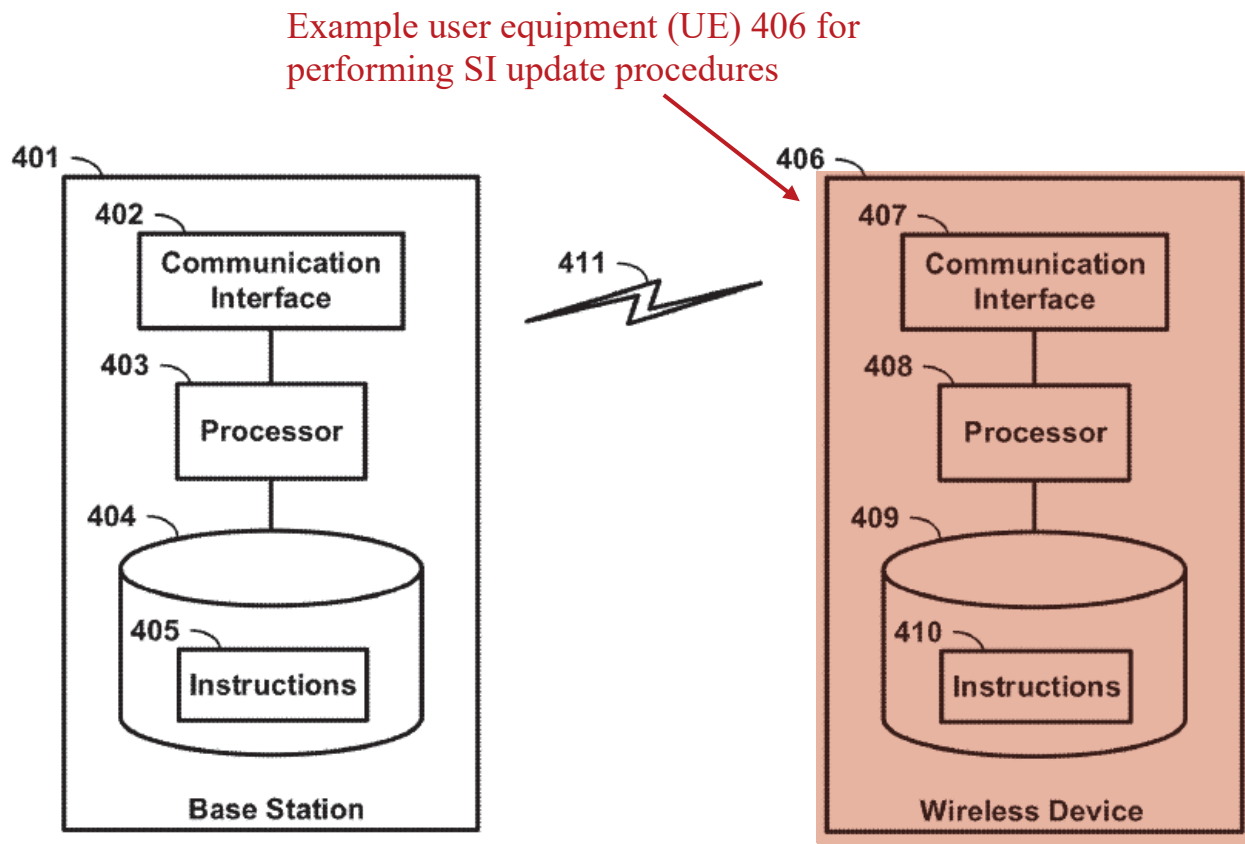
147. A POSITA would have understood that, because ITRI teaches the UE receiving the updated SIB(s) in the next modification period, it would have been obvious for the UE to “*complet[e] the SI update of the required changed SIBs within the next modification period*” by immediately using the newly acquired updated SIB(s). Indeed, it would have been advantageous and predictable for the UE to use the newly acquired updated SIB(s) as soon as they are acquired (*i.e.*, in the next modification period) so that the UE is using up-to-date system information to avoid a connection or network error due to using incorrect and outdated SIB(s).

148. Thus, ITRI teaches the UE acquiring updated SI in the next modification period, including SIB1 and any updated SIB(s) based on value tags, which renders obvious, “*completing the SI update of the required changed SIBs within the next modification period in response to receiving the content of the required changed SIBs.*”

10. Claim 11

[11.0] A user equipment (UE) for wireless communication, comprising:

149. Jeon describes a “UE user equipment” for wireless communication using BWPs. Jeon, ¶¶0132, 0276. Fig.4 of Jeon below illustrates an example UE. Jeon, Fig.4, ¶0146.



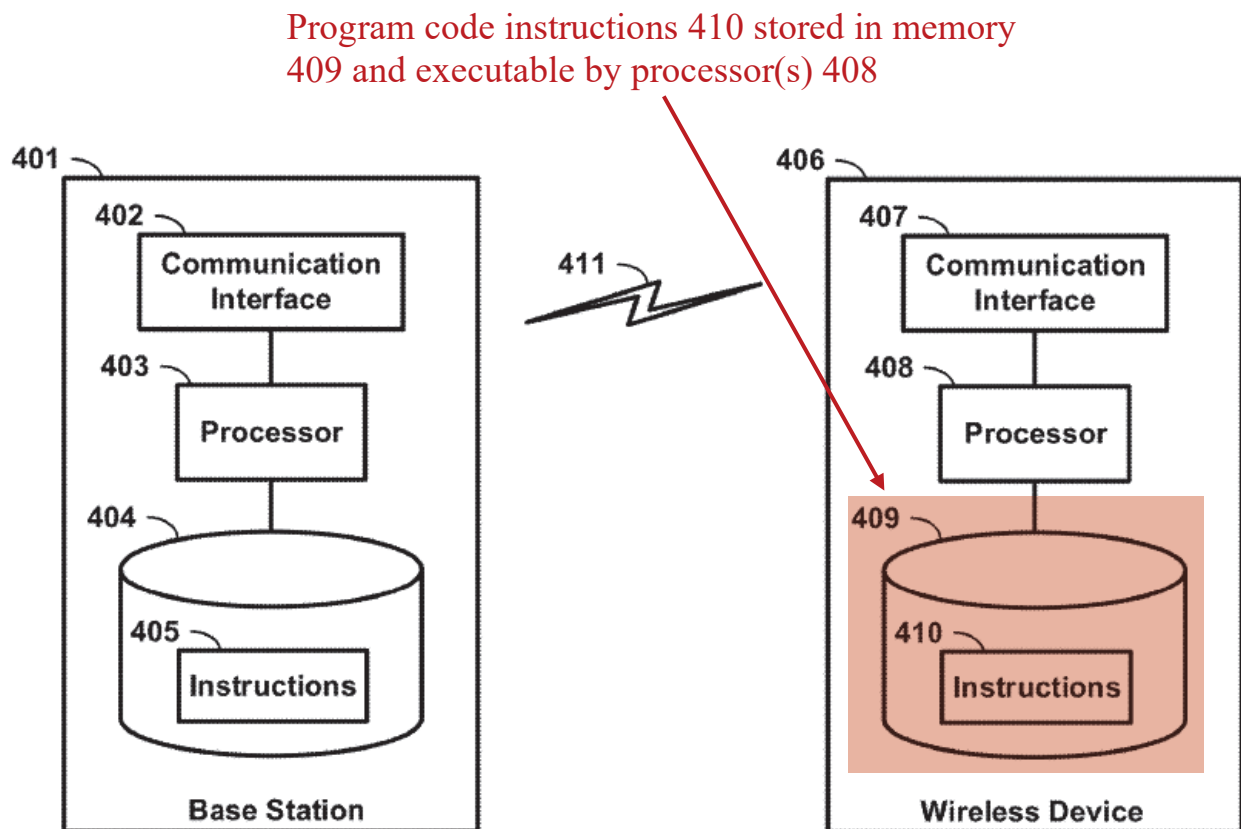
Jeon, Fig.4 (annotated).

150. ITRI and Liao further describe details for an example UE configured for SI update procedures, as discussed above. ITRI, 1-3; Liao, 7:41-53. A POSITA would have found it obvious to implement Jeon's example UE and SI update techniques in ITRI's system for SI update at least for the reasons provided above at Section IX.C.5.

151. Thus, Jeon's UE, in view of ITRI's and Liao's techniques for SI update, render obvious "[a] user equipment (UE) for wireless communication."

[11.1] a non-transitory machine-readable medium storing computer-executable instructions;

152. Jeon teaches an example UE that includes “at least one set of **program code instructions 410 stored in non-transitory memory 409 and executable by the one or more processors 408.**” Jeon, ¶0146. Fig. 4 below illustrates program code instructions 410 stored in non-transitory memory 409, which is coupled to a processor(s) 408.

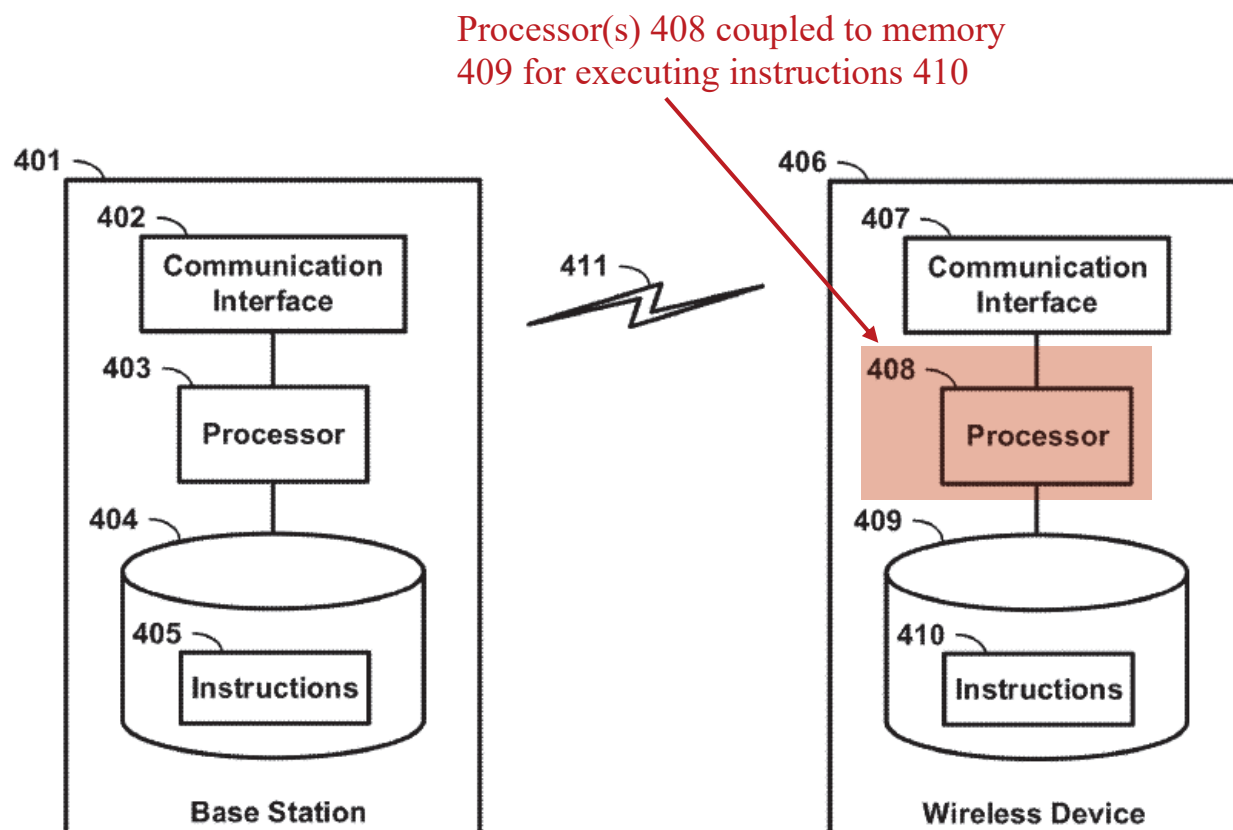


Jeon, Fig.4 (annotated).

153. Thus, Jeon’s UE including program code instructions stored in non-transitory memory instructions and executable by processors, in view of ITRI’s system and Liao’s techniques for SI update, render obvious “*a non-transitory machine-readable medium storing computer-executable instructions.*”

[11.2] *a processor coupled to the non-transitory computer-readable medium, and configured to execute the computer-executable instructions to cause the UE of a connected state to perform operations comprising:*

154. As discussed at [11.1], Jeon teaches a UE including “at least one set of program code instructions 410 stored in **non-transitory memory 409** and **executable by the one or more processors 408.**” Jeon, ¶0146. Fig. 4 below illustrates program code instructions 410 stored in non-transitory memory 409, which is coupled to a processor(s) 408 for causing the UE to perform operations such as SI update procedures. Jeon, Fig.4, ¶¶0146, 0297.



Jeon, Fig.4 (annotated).

155. Thus, Jeon’s connected-mode UE including program code instructions

stored in non-transitory memory instructions and executable by processors, in view of ITRI's system and Liao's techniques for SI update, render obvious "*a processor coupled to the non-transitory computer-readable medium, and configured to execute the computer-executable instructions to cause the UE of a connected state to perform operations comprising.*"

[11.3] *receiving a system information (SI) change indication broadcasted by a paging via a currently active bandwidth part (BWP) during a modification period;*

156. ITRI in view of Liao and Jeon render obvious this element; see element [1.1] above.

[11.4] *in response to receiving the SI change indication, switching from currently active BWP to an initial active BWP for an SI update; and*

157. ITRI in view of Liao and Jeon render obvious this element; see element [1.2] above.

[11.5] *receiving remaining minimum SI (RMSI) via the initial active BWP during a next modification period that immediately follows the modification period,*

158. ITRI in view of Liao and Jeon render obvious this element; see element [1.3] above.

[11.6] *wherein the RMSI includes information associated with changed system information block (SIB);*

159. ITRI in view of Liao and Jeon render obvious this element; see element [1.4] above.

[11.7] *determining which of the changed SIBs is required to be updated for the UE according to the received RMSI; and*

160. ITRI in view of Liao and Jeon render obvious this element; see element [1.5] above.

[11.8] *receiving content of the required changed SIBs based on the determination.*

161. ITRI in view of Liao and Jeon render obvious this element; see element [1.6] above.

11. Claim 12

[12.0] *The UE of claim 11, wherein the currently active BWP is switched to the initial active BWP automatically on the end of the modification period.*

162. ITRI in view of Liao and Jeon render obvious this element; see claims 11 and 2 above.

12. Claim 14

[14.0] *The UE of claim 11, wherein the currently active BWP is switched to the initial active BWP in response to receiving downlink control information (DCI).*

163. ITRI in view of Liao and Jeon render obvious this element; see claims 11 and 4 above.

13. Claim 15

[15.0] *The UE of claim 11, wherein the processor is further configured to execute the computer-executable instructions to cause the UE of a connected state to perform operations comprising: completing the SI update of the required changed SIBs within the next modification period in response to receiving the content of the required changed SIBs.*

164. ITRI in view of Liao and Jeon render obvious this element; see claims

11 and 5 above.

E. Ground 2: Claims 3 and 13 are obvious under 35 U.S.C. § 103 over ITRI in view of Liao, Jeon, and Huawei

1. Summary of Huawei

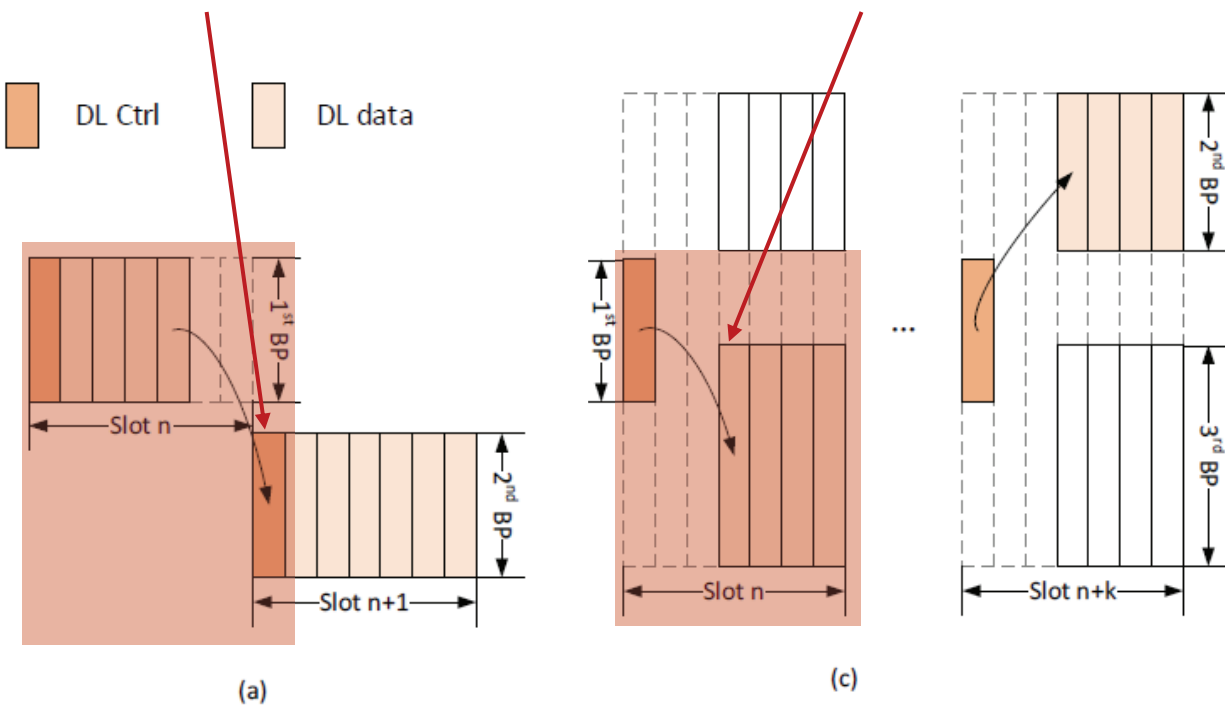
165. Huawei describes configuring the “frequency location” and “control for RMSI” delivery to UEs in 5G. Huawei, 5-6. Huawei also describes techniques for “bandwidth part switching.” Huawei, 1-2.

166. For example, Huawei teaches that “the UE receives both DL control information and DL data within the 1st bandwidth part during slot n while the UE switches to the 2nd bandwidth part during slot n+1.” Huawei, 2. As another example, the UE switches to the 2nd bandwidth part during the same slot n. Huawei, 2.

167. In Fig.2 below, Huawei illustrates these examples of receiving downlink control data in a first BWP and switching to a second BWP in the next time slot (Fig.2(a), left) or in the same time slot (Fig.2(c), right). Huawei, Fig.2, 2.

After receiving DL control data in slot n, the UE switches BWPs in the next slot n+1

After receiving DL control data, the UE switches BWPs within the same slot n



Huawei, Fig.2(a) and (c) (annotated).

2. Reasons to Combine ITRI, Liao, and Jeon with Huawei

168. For the reasons set forth below, a POSITA would have been motivated to combine the teachings of ITRI, Liao, and Jeon with Huawei. In particular, before the priority date of the '238 patent, it would have been obvious, beneficial, and predictable to utilize Huawei's teachings regarding immediate BWP switching in combination with the system of ITRI, Liao, and Jeon—for example, to immediately switch BWPs upon receiving an SI change notification.

169. As an initial matter, one of ordinary skill in the art when considering

the teachings of ITRI, Liao, and Jeon would have naturally considered the teachings of Huawei as they are all analogous prior art pertaining to the same field of endeavor as the '238 patent, namely, cellular telecommunications. *See* Huawei, 1. Specifically, like the '238 patent, Huawei describes RMSI acquisition in the context of 5G. Huawei, 5-6. Huawei is also pertinent to the particular problem of the '238 patent, such as SI acquisition procedures and BWP switching to reduce network load in 5G. *See, e.g.*, Huawei, 5-6.

170. As described above at Section IX.C.5, a POSITA would have found it obvious to combine ITRI's system with Liao's and Jeon's technique for SI update. A POSITA also would have found it beneficial and predictable to include Huawei's teachings regarding BWP switching in the combined system. Huawei, Fig.2, 1-2. For instance, Huawei teaches it was well known that, after receiving control information in a first BWP, to switch to a second BWP immediately, *i.e.*, either in the same time slot (*i.e.*, before the current time slot ends) or at the start of the next time slot. Huawei, Fig.2, 1-2. It would have been obvious to apply this technique to the system of ITRI, Liao, and Jeon, so that in the resulting combination, the UE switches to the initial BWP immediately after (*e.g.*, next or same time slot) receiving an SI change notification. *See* ITRI, 1-2; Liao, 7:41-53, 8:49-53; Jeon, ¶¶0290, 0297, 0376; Huawei, Fig.2, 1-2.

171. Indeed, this combination would have been obvious because it was

specifically contemplated in other prior art references as well. For instance, the Dawid reference explains: “[t]he signalling used to switch the BWP may contain information that **the BWP switch is made because of a SI update required ... so that the UE will read SIBs** at the correct time, such as a next modification period or **immediately.**” Dawid, 16:16-19).

172. One of ordinary skill in the art would have been specifically motivated to incorporate Huawei’s technique of immediate BWP switching into the system of ITRI, Liao, and Jeon because doing so would address a well-known issue pertaining to SI update—*i.e.*, when an SI update is needed immediately. In other words, Huawei’s technique solves the problem when a UE immediately needs the SI update (by immediately switching to the initial BWP for updated RMSI) in order to continue service on the network. Kim, ¶0422; Hoglund, ¶0079 (describing UE may “need to apply updated SI in order to successfully receive paging messages” or due to “bandwidth changes”); Lee, ¶0231 (describing “system information update is necessary before communication/transmission and reception of a message”). Therefore, a POSITA would have been motivated to incorporate Huawei’s teachings into ITRI’s system for SI update.

173. This combination would have been predictable with an expectation of success because, as was common in the art, “the UE may immediately perform SI reacquisition (SI refresh) when recognizing the occurrence of the SI update.” Kim,

¶0422. A POSITA would have also found the combination predictable and would have had a reasonable expectation of success, as the combination does not change the intended functionality of any of Liao's or Jeon's techniques. Further, any modification to ITRI's teachings so that the UE switches BWPs immediately (as opposed to waiting until the end of the current modification period) is consistent with ITRI's SI update technique—as the UE would still switch BWPs prior to the next modification period and thus would be ready to update its SI in the next modification period, as taught by ITRI.

174. A POSITA also would have expected success as Huawei's BWP switching technique was *specifically intended* to be implemented in response to the UE receiving downlink information or DCI instructing the UE to switch BWPs. Huawei, 5-6. Therefore, it would have been obvious to apply Huawei's technique in ITRI's system, where the UE would switch BWPs to obtain RMSI in response to receiving downlink control information in the form of an SI update notification. ITRI, 1-2; Huawei, 1-2, 5-6.

175. Accordingly, a POSITA would have found it obvious to apply Huawei's teachings to ITRI, Liao, and Jeon because the combination merely amounts to implementing a known BWP switching technique in ITRI's system ready for improvement.

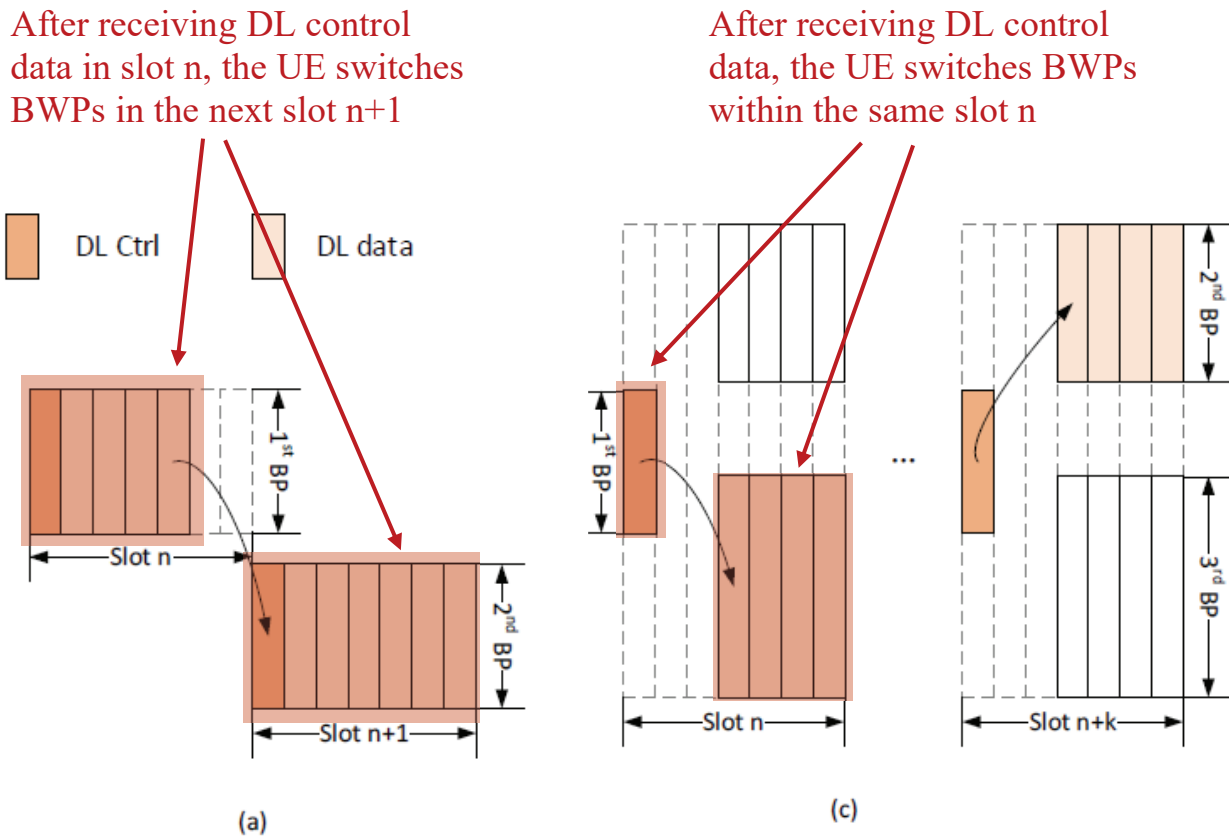
3. Claim 3

[3.0] *The method of claim 1, wherein the currently active BWP is switched to the initial active BWP immediately upon receiving the SI change indication.*

176. First, ITRI in view of Liao and Jeon renders obvious the method of claim 1, as discussed above.

177. Second, Huawei teaches techniques for “bandwidth part switching.” Huawei, 1. For instance, Huawei teaches it was known in the art to receive data on one BWP and switch to another BWP in the next time slot or even the same time slot. Huawei, Fig.2, 2.

178. Fig.2 below illustrates these examples where a UE switches BWPs “*immediately*” after receiving downlink control information, including in the next slot (Fig.2(a)) or within the same time slot (Fig.2(c)). Huawei, Fig.2, 2, 4.



Huawei, Fig.2(a) and (c) (annotated).

179. A POSITA would have found it obvious to combine the teachings of Huawei with ITRI, Liao, and Jeon at least for the reasons provided above at Section IX.D.2. For instance, a UE can advantageously switch to the initial BWP in the next or same time slot, in response to receiving an SI change notification, because the UE may immediately need an SI update in order to continue receiving service.

180. Thus, Huawei teaches a UE switching BWPs in the same or next time slot in response to receiving downlink control information, which, in view of ITRI,

Liao, and Jeon, renders obvious “*wherein the currently active BWP is switched to the initial active BWP immediately upon receiving the SI change indication.*”

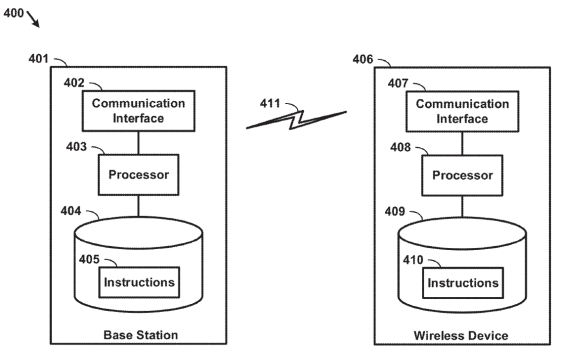
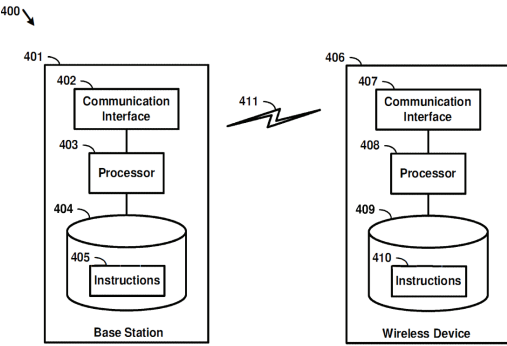
4. Claim 13

[13.0] *The UE of claim 11, wherein the currently active BWP is switched to the initial active BWP immediately upon receiving the SI change indication.*

181. ITRI in view of Liao, Jeon, and Huawei render obvious this element; see claims 11 and 3 above.

X. COMPARISON CHART OF JEON VERSUS JEON PROVISIONAL

182. Below I provide a comparison chart. The chart compares the disclosures relied upon in the Petition and in my declaration from Jeon (Ex.1010) in the left column and the corresponding disclosures of U.S. Provisional App. No. 62/577,995 (“Jeon Provisional,” Ex.1011) in the right column. In general, I aimed to avoid unnecessary repetition of duplicative evidence. As the chart shows, there are no substantive differences between Jeon and the corresponding disclosures of Jeon Provisional. To the extent there are differences I have not referenced as a note in the chart below, their absence from the chart should not be taken as indicative of any material difference between the references. Thus my citations above to the Jeon reference are also citations to the corresponding disclosure in the Jeon Provisional.

Jeon	Provisional 62/577,995 (Jeon Provisional)
 Jeon, Fig.4.	 Jeon Provisional, Fig.4.
“UE user equipment.” Jeon, ¶0132.	“UE user equipment.” Jeon Provisional, ¶0021.
“The wireless device 406 may include at least one communication interface	“The wireless device 406 may include at least one communication interface 407,

407, one or more processors 408, and at least one set of program code instructions 410 stored in non-transitory memory 409 and executable by the one or more processors 408.” Jeon, ¶0146.	at least one processor 408, and at least one set of program code instructions 410 stored in non-transitory memory 409 and executable by the at least one processor 408.” Jeon Provisional, ¶0031.
“A DL BWP other than the initial active DL BWP may be configured as the default DL BWP for a wireless device. Reconfiguring the default DL BWP may be performed based on load balancing and/or different numerologies used for an active DL BWP and an initial active DL BWP. A default BWP on a PCell may be an initial active DL BWP for a transmission of RMSI. The transmission of RMSI may comprise one or more of an RMSI CORESET with a CSS, and/or a wireless device-specific search space (e.g., USS). The initial active BWP and/or default BWP may remain an active BWP for a user after a wireless device becomes RRC connected.” Jeon, ¶0276.	“In an example embodiment, a DL BWP other than the initial active DL BWP may be configured to a UE as the default DL BWP. The reconfiguring the default DL BWP may be due to load balancing and/or different numerologies employed for active DL BWP and initial active DL BWP. In an example embodiment, a default BWP on Pcell may be an initial active DL BWP for transmission of RMSI, comprising RMSI CORESET with CSS. The RMSI CORESET may comprise USS. The initial active/default BWP may remain active BWP for the user also after UE becomes RRC connected.” Jeon Provisional, ¶¶00154-00155.
“Downlink and uplink BWPs may be independently activated, such as for a paired spectrum. Downlink and uplink bandwidth parts may be jointly activated, such as for an unpaired spectrum. In bandwidth adaptation (e.g., where the bandwidth of the active downlink BWP may be changed), a joint activation of a new downlink BWP and a new uplink BWP may be performed (e.g., for an unpaired spectrum). A new DL/UL BWP pair may be activated such that the bandwidth of the uplink BWPs	“In an example embodiment, for a paired spectrum, downlink and uplink bandwidth parts may be independently activated while, for an unpaired spectrum downlink and uplink bandwidth parts are jointly activated. In case of bandwidth adaptation, where the bandwidth of the active downlink BWP may be changed, there may, in case of an unpaired spectrum, be a joint activation of a new downlink BWP and new uplink BWP. For example, a new DL/UL BWP pair where the bandwidth of the uplink BWPs may be the same

may be the same (e.g., there may not be a change of an uplink BWP).” Jeon, ¶0277.	(e.g., no change of uplink BWP).” Jeon Provisional, ¶00157.
“A wireless device may monitor for RMSI and broadcasted OSI, which may be transmitted by a base station within a common search space (CSS) on the PCell. RACH response and paging control monitoring on the PCell may be transmitted within the CSS. A wireless device may not monitor the common search space, for example, if the wireless device is allowed to be on an active BWP configured with a wireless device-specific search space (USSS or USS).” Jeon, ¶0286.	“In an example embodiment, UE may monitor for RMSI and broadcast OSI which may be transmitted by the gNB within the common search space (CSS) on the PCell. In an example, RACH response and paging control monitoring on the PCell may be transmitted within the CSS. In an example, when a UE is allowed to be on an active BWP configured with DE-specific search space (USSS or USS), the UE may not monitor the common search space.” Jeon Provisional, ¶00169.
“Group-common search space (GCSS) may be supported (e.g., in NR). The GCSS may be used in addition to or as an alternative to CSS for certain information. A base station may configure GCSS within a BWP for a wireless device. Information such as RACH response and paging control may be transmitted on GCSS. The wireless device may monitor GCSS, for example, instead of switching to the BWP containing the CSS for such information.” Jeon, ¶0290.	“In an example embodiment, NR may support group-common search space (GCSS). For example, the GCSS may be employed as an alternative to CSS for certain information. In an example, gNB may configure GCSS within a BWP for a UE, and information such as RACH response and paging control may be transmitted on GCSS. For example, the UE may monitor GCSS instead of switching to the BWP containing the CSS for such information.” Jeon Provisional, ¶00174.
“The wireless device may or may not autonomously switch to a default BWP[.]” Jeon, ¶0293.	“In an example, autonomous switching to DL default BWP[.]” Jeon Provisional, ¶00301.
“At least one of configured DL BWPs may comprise one CORESET with common search space (CSS), for example, at least in a primary component carrier. The CSS may be needed at least for RACH response	“In an example embodiment, at least one of configured DL BWPs comprises one CORESET with common search space (CSS) at least in primary component carrier. The CSS may be needed at least for RACH response

(e.g., a msg2) and/or a pre-emption indication. One or more of configured DL bandwidth parts for a PCell may comprise a CORESET with the CSS type for RMSI and/or OSI, for example, if there is no periodic gap for RACH response monitoring on the PCell. A configured DL bandwidth part for a PCell may comprise one CORESET with the CSS type for RACH response and paging control for a system information update. A configured DL bandwidth part for a serving cell may comprise a CORESET with the CSS type for a pre-emption indication and/or other group-based commands.” Jeon, ¶0297.	(msg2) and pre-emption indication. In an example, for the case of no periodic gap for RACH response monitoring on Pcell, for Pcell, one of configured DL bandwidth parts may comprise one CORESET with the CSS type for RMSI & OSI. For Pcell, a configured DL bandwidth part may comprise one CORESET with the CSS type for RACH response & paging control for system information update. For a serving cell, a configured DL bandwidth part may comprise one CORESET with the CSS type for pre-emption indication and other group-based commands.” Jeon Provisional, ¶00185.
“To monitor common channel or group common channel for a connected wireless device (e.g., RRC CONNECTED UE), an initial DL BWP may comprise a control channel for RMSI, OSI, and/or paging. The wireless device may switch a BWP to monitor such a control channel. A configured DL BWP may comprise a control channel (e.g., for a Msg2). A configured DL BWP may comprise a control channel for a SFI. A configured DL BWP may comprise a pre-emption indication and/or other group common indicators such as for power control.” Jeon, ¶0299.	“In an example embodiment, to monitor (group) common channel for RRC CONNECTED DE, an initial DL BWP may comprise control channel for RMSI, OSI and paging and UE switches BWP to monitor such channel. In an example, a configured DL BWP may comprise control channel for Msg2. In an example, a configured DL BWP may comprise control channel for SFI. In an example, a configured DL BWP may comprise pre-emption indication and other group common indicators like power control.” Jeon Provisional, ¶00189.
“An initial active DL BWP may be defined as frequency location and bandwidth of RMSI CORESET and numerology of RMSI. The PDSCH delivering RMSI may be confined within the initial active DL BWP. A	“In an example embodiment, an initial active DL BWP may be defined as frequency location and bandwidth of RMSI CORESET and numerology of RMSI., wherein PDSCH

wireless device may be configured with PRB bundling size(s) per BWP.” Jeon, ¶0376.	delivering RMSI may be confined within the initial active DL BWP.” Jeon Provisional, ¶00271.
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XI. SUPPORT IN JEON PROVISIONAL FOR CLAIM IN JEON

183. The table below indicates support in Jeon Provisional for at least one claim of Jeon. I have been informed that this table is not required for Jeon to obtain the benefit of the filing date of Jeon Provisional, but I have nonetheless been requested to provide a table demonstrating that Jeon Provisional provides support for at least one claim of Jeon.

Claim in Jeon	Support in Jeon Provisional
1. A method comprising: receiving, by a wireless device from a base station, at least one message comprising:	“[A] wireless device may receive, from a base station, at least one RRC message comprising grant.” Jeon Provisional, ¶00363; <i>see also id.</i> at ¶00353.
configuration parameters for a plurality of bandwidth parts of a cell; and	“configuration parameters for indicating at least one of following: one or more bandwidth parts (BWPs);” Jeon Provisional, ¶00363; <i>see also id.</i> at ¶00353.
an index associated with the wireless device;	“a first identifier of the wireless device;” Jeon Provisional, ¶00363; <i>see also id.</i> at ¶00353.
receiving, via a control channel of a first bandwidth part, downlink control information (DCI) comprising a plurality of bandwidth part identifiers;	“The wireless device may attempt a detection of a PDCCH with a group common DCI at least based on a size associated with the one of the at least one IE, wherein the group-common DCI comprising at least one BWP identifier associated with one of the one or more BWPs.” Jeon Provisional, ¶00363; <i>see also id.</i> at ¶00353.
determining, based on the index, a position of a first bandwidth part identifier in the DCI; and	“a position of the first indicator is identified at least based on the index of the wireless device ... [in a] group-

	common DCI[;]" Jeon Provisional, ¶00353; <i>see also id.</i> at ¶¶00350, 00355.
switching from the first bandwidth part to a second bandwidth part indicated by the first bandwidth part identifier.	"The wireless device may determine ... whether to switch a BWP to a first BWP associated the at least one BWP identifier." Jeon Provisional, ¶00363 <i>see also id.</i> at ¶00353.

XII. COMPARISON CHART OF LIAO VERSUS LIAO PROVISIONAL

184. Below I provide a comparison chart. The chart compares the disclosures relied upon in the Petition and in my declaration from Liao (Ex.1008) in the left column and the corresponding disclosures of U.S. Provisional App. No. 62/544,118 (“Liao Provisional,” Ex.1009) in the right column. In general, I aimed to avoid unnecessary repetition of duplicative evidence. As the chart shows, there are no substantive differences between Liao and the corresponding disclosures of Liao Provisional. To the extent there are differences I have not referenced as a note in the chart below, their absence from the chart should not be taken as indicative of any material difference between the references. Thus my citations above to the Liao reference are also citations to the corresponding disclosure in the Liao Provisional.

Liao	Provisional 62/544,118 (Liao Provisional)
“The BWP switch can be based two or more combined methods including a higher-layer signaling, such as the RRC-layer signaling or a MAC CE; a physical-layer signaling, such as the DL control information (DCI); and the time pattern. The UE broadcast and/or multi-cast message includes at least the system information, the random access (RA) response in RA procedure, paging control for system information update[.]” Liao, 7:41-53.	“BWP switch can be based on one of the following or a combination of two or more[:] Higher-layer signaling (e.g. RRC-layer signaling, MAC CE)[;] Physical-layer signaling (e.g. downlink control information)[;] Time pattern[.] Broadcast/Multi-cast message includes at least the following[:] System information[;] Random access response in random access procedure[;] Paging control for system information updates[.]” Liao Provisional, 24-25.

“If the current active BWP for the UE does not include a CORESET with CSS, the UE can switch its active BWP to the one including a CORESET with CSS scheduler during the time gap for the monitoring of broadcast message, such as SI, RA response, paging control, and etc.” Liao, 8:49-53.	“A UE can switch its active BWP to the one including a CORESET with common search space for the monitoring of broadcast message (e.g. system information) random access response, paging control etc.) scheduler during the time gap if its current active BWP doesn’t include a CORESET with common search space.” Liao Provisional, 26.
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XIII. SUPPORT IN LIAO PROVISIONAL FOR CLAIM IN LIAO

185. The table below indicates support in Liao Provisional for at least one claim of Liao. I have been informed that this table is not required for Liao to obtain the benefit of the filing date of Liao Provisional, but I have nonetheless been requested to provide a table demonstrating that Liao Provisional provides support for at least one claim of Liao.

Claim in Liao	Support in Liao Provisional
11. A method, comprising: receiving a higher-layer signaling containing the configuration of one or more bandwidth parts (BWPs) per cell by a user equipment (UE) in a wireless communication network, wherein each BWP includes one or more contiguous physical resource blocks (PRBs);	“A method of robust active DL bandwidth part indication[.]” Liao Provisional, 35. “Configuration of a BWP includes the following ... A UE can be configured with single or multiple BWPs.” Liao Provisional, 15. “A BWP consists of a group of contiguous PRBs.” Liao Provisional, 15.
detecting a DL BWP activation signal to activate a first DL BWP, wherein the DL BWP activation signal is sent over all configured DL BWPs through a timer-triggered transmission from a gNB that failed to receive any uplink (UL) transmission from the UE when a gNB-side BWP-timer expired, and wherein the gNB-side BWP-timer is started by the gNB when a previous DL BWP activation signal is sent to the UE to activate the first BWP; and	“Transmitting new active DL bandwidth part indication by DCI in current active DL bandwidth part for a UE to the UE[;] Triggering a timer if no uplink transmission is received from the UE for DL/UL scheduling in the active UL bandwidth part[;] Transmitting active DL bandwidth part indication by DCI in all DL bandwidth part configured to the UE when the timer expires[.]” Liao Provisional, 35.

activating the first DL BWP based on the detected DL BWP activation signal.	“At least one active DL/UL BWP for a UE at a given time[.] ... Active BWP switch in connected mode[.]” Liao Provisional, 13-14. “Transmitting new active DL bandwidth part indication by DCI in current active DL bandwidth part for a UE to the UE[.]” Liao Provisional, 35.
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XIV. CONCLUSION

186. This declaration and my opinions herein are made to the best of my knowledge and understanding, and based on the material available to me, at the time of signing this declaration. I declare that all statements made herein on my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 or Title 18 of the United States Code.

Mar. 20, 2023
Date: _____



Zhi Ding

Digitally signed by
Zhi Ding
Date: 2023.03.20
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