

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

TOGAIL TECHNOLOGIES LTD.,
Patent Owner.

IPR2023-00721
U.S. Patent No. 10,972,972

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

TABLE OF CONTENTS

I.	Introduction	4
II.	Qualifications and Professional Experience.....	6
III.	Level of Ordinary Skill in the Art	12
IV.	Relevant Legal Standards.....	13
V.	Overview of the '972 Patent and Related Technology	15
VI.	Prosecution History of the '972 Patent	21
VII.	Claim Construction	23
VIII.	Identification of How the Claims are Unpatentable.....	25
A.	Ground 1: Claims 1, 2, 9-12, 14, 15, 16, 23-26, and 28 are obvious under 35 U.S.C. § 103 in view of Xi	25
1.	Summary of Xi.....	25
2.	Claim 1	32
3.	Claim 2	54
4.	Claim 9	56
5.	Claim 10	59
6.	Claim 11	60
7.	Claim 12	62
8.	Claim 14	64
9.	Claim 15	69
10.	Claim 16	71
11.	Claim 23	71
12.	Claim 24	72
13.	Claim 25	72
14.	Claim 26	73

15.	Claim 28	73
B.	Ground 2: Claims 8, 13, 14, 22, 27, and 28 are obvious under 35 U.S.C. § 103 over Xi combined with Deenoo.....	74
1.	Summary of Deenoo	74
2.	Reasons to Combine Xi and Deenoo	75
3.	Claim 8	79
4.	Claim 13	84
5.	Claim 22	88
6.	Claim 27	89
IX.	Comparison Chart of Xi Versus Xi-provisional.....	91
X.	Support in XI-provisional for claim in Xi.....	105
XI.	Conclusion.....	108

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. 10,972,972 (“the ’972 patent”) to Meister, *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, 2, 8-16, and 22-28 (“the Challenged Claims”) of the ’972 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 ’972 patent, Ex.1001;
- b. the prosecution history of the ’972 patent (“’972 File History”),

Ex.1002;

- c. U.S. Application Publication No. 2020/0288479 by F. Xi et al. (“**Xi**”), Ex.1005; and
- d. U.S. Application Publication No. 2020/0280409 to Y. Deenoo et al. (“**Deenoo**”), Ex.1006;
- e. WIPO Publication WO 2019/219162, Ex.1007;
- f. U.S. Provisional Application No. 62/652,805 (“**Xi-Provisional**”), Ex.1008;
- g. Y. Huang et al., “Multi-Panel MIMO in 5G,” *IEEE Comm. Mag.*, pp. 56-61, March 2018, Ex.1009;
- h. J. Razavilar et al., “Software Radio Architecture with Smart Antennas: A Tutorial on Algorithms and Complexity,” *IEEE Journal on Selected Areas in Communication*, pp. 662-676, April 1999, Ex.1010;
- i. H. Newton, *Newton’s Telecom Dictionary, 26th Expanded and Updated Edition*, 2011 (selected pages), Ex.1011;
- j. U.S. Patent No. 9,432,977, Ex.1012;
- k. U.S. Patent Pub. No. 2020/0077432, Ex.1013;
- l. U.S. Patent Pub. No. 2019/0373667, Ex.1014;
- m. WIPO Publication WO 2019/219162, Ex.1015;
- n. U.S. Patent No. 11,271,635, Ex.1016; and

o. U.S. Provisional App. No. 62/653,824 (provisional application of Ex.1016), Ex.1017.

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 University of California Davis. I have served as a faculty member at several US universities for over 32 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 15,000 times according to Google Scholar¹, I am also co-inventor of

¹ <https://scholar.google.com>

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 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 '972 patent is July 17, 2018. I am familiar with the wireless communications art pertinent to the '972 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 '972 patent, a person of ordinary skill in the art ("POSITA") in the field of the '972 patent, as of the earliest possible priority date of July 17, 2018, 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 work 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 '972 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 '972 patent (i.e., July 17, 2018). 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 '972 patent.

IV. RELEVANT LEGAL STANDARDS

22. I am not an attorney. In preparing and expressing my opinions and considering the subject matter of the '972 patent, I am relying on certain basic legal principles that counsel explained to me. These principles are discussed below.

23. I understand that prior art to the '972 patent includes patents and printed publications in the relevant art that predate the priority date of the alleged invention recited in the '972 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 reasonably 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 '972 PATENT AND RELATED TECHNOLOGY

29. The '972 patent generally relates to wireless communication devices, such as mobile devices or UEs, that include one or more antenna panels. For example, “[a]s shown in FIG. 1, a wireless communication device 100 includes

four antenna panels 102, 104, 106 and 108.” ’972 patent, 7:4-6.

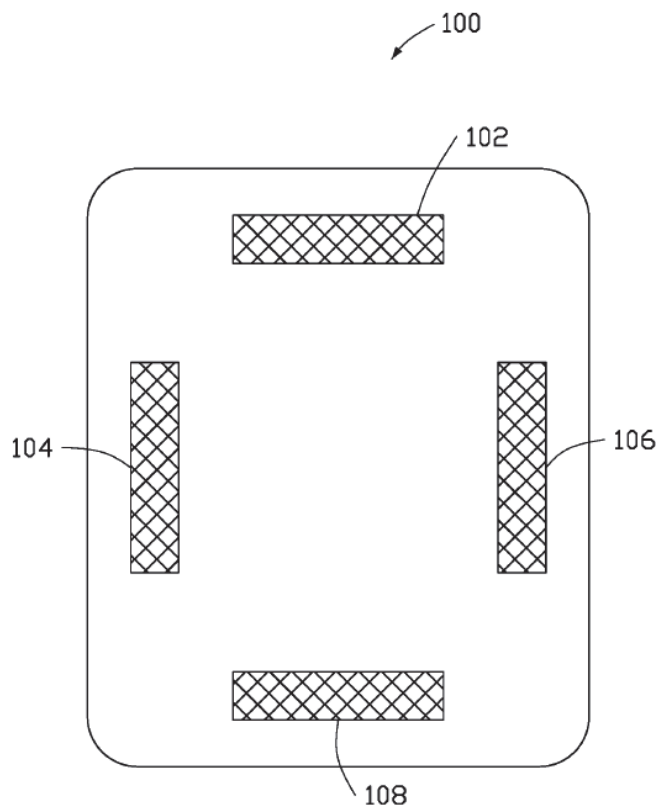


FIG. 1

30. As was known in the art and explained in the Background section of the ’972 patent

Multi Input Multi Output (MIMO) is one of the key features in the next generation wireless communication systems. With the MIMO technology, **a number of antenna panels at the transceiver/receiver can bring extra degrees of freedom to increase the data throughput, beamforming gain and coverage.**

'972 patent, 1:25-31. Each antenna panel may include a number of physical antennas. '972 patent, 7:6-11 ("The antenna panels described herein may be referred to antenna arrays or antenna ports. The antenna arrays may include a number of physical antennas...").

31. The '972 patent references beamforming and beam switching. See, e.g., '972 patent, 1:27-31 ("With the MIMO technology, a number of antenna panels at the transmitter/receiver can...increase the...**beamforming** gain."); 6:24-27 ("The leading time for **beam switching**..."), concepts that were well understood in the art. For example, beamforming refers to the use of an antenna array to be able to focus and direct energy toward another device in the form of a radio beam. See, e.g., Ex.1010, 663 ("The block diagram of an adaptive array is depicted in Fig. 1. In general, the objective is to form the main beam toward the desired user and nulls toward the interference sources as illustrated in Fig. 2."); Ex.1011, 182 (definitions of "beam" and "beamforming," which states "Techniques for sending a directional signal rather than an omnidirectional to improve signal strength.").

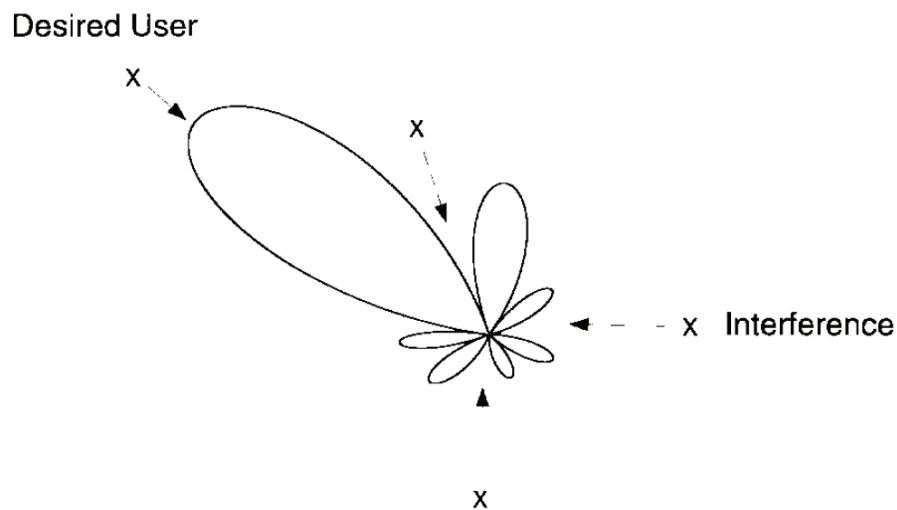


Fig. 2. Sample array pattern.

Ex.1010, Figure 2

32. Though an antenna array may be in a fixed location, the beam direction is dynamic in space and time so that the antenna pattern may be concentrated in a desired direction, thus increasing the signal energy transmitted (if beamforming is implemented in the transmitter) and/or received (if beamforming is implemented in the receiver) in that direction. *See, e.g.,* Ex.1010, 663 (“The smart antenna’s beams are not fixed, but are dynamic per user, and will place nulls that cancel interference.”). The figure below illustrates multi-panel transmission (captioned “Multi-Panel MIMO transmission”) and use of beamforming when multiple panels are implemented in a base station or access point.

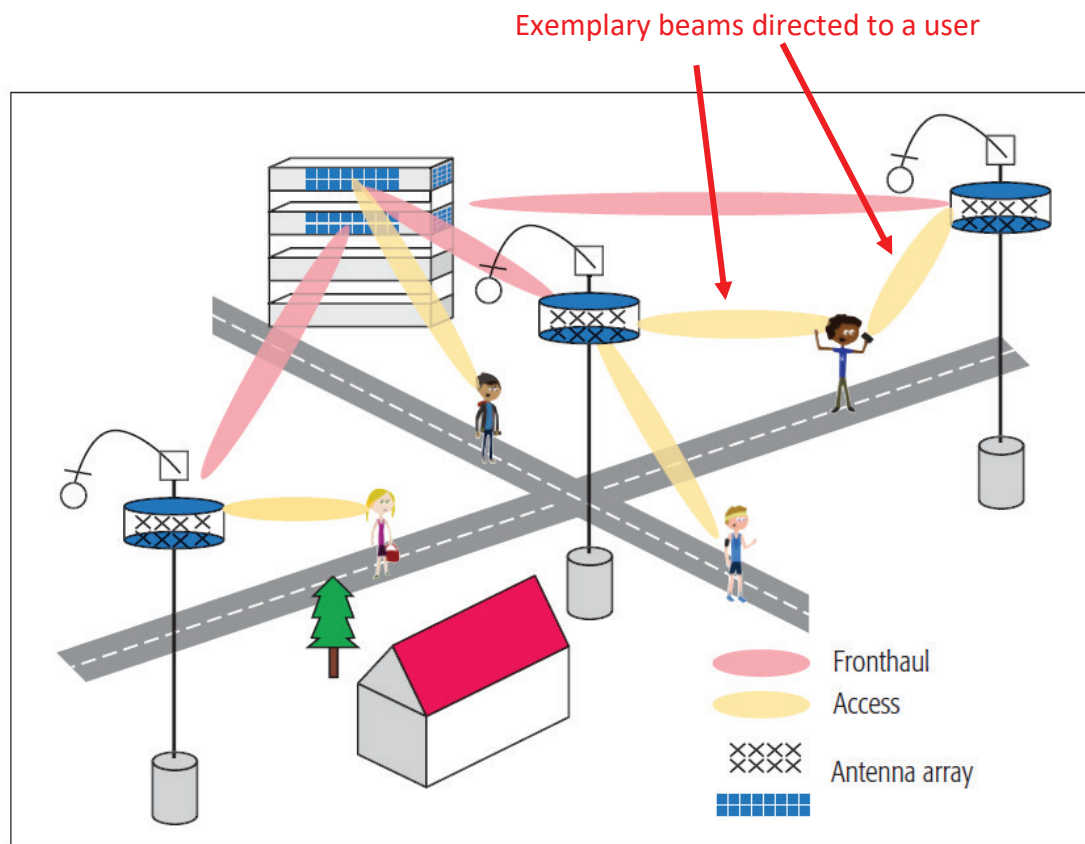


Figure 1. Multi-panel MIMO transmission in 5G

Ex.1009, Figure 1 (at 57) (annotated in red)

33. The '972 patent explains a problem concerning scheduling offset values and multi-panel UEs. The term “scheduling offset” or “scheduling offset value” was a term of art known to POSITAs as generally related to the time offset between a scheduling assignment message received in a Physical Downlink Control Channel (PDCCH) and the corresponding Physical Downlink Shared Channel (PDSCH) message scheduled by the PDCCH message. *See, e.g., Xi*, [0087] (“a scheduling offset or scheduling delay of the corresponding NR-PDSCH allocation”); [0090] (“scheduling offset or time offset for the reception or

demodulation of NR-PDSCH”); Xi-Provisional, [0082], [0084]. The ’972 patent confirms this understanding:

For DL transmissions, the scheduling offset may be referred as a time period starting from the end of a PDCCH to the beginning of a PDSCH. For example, the scheduling offset may be a time period that starts from the first symbol after the end of the PDCCH to the first symbol of the PDSCH scheduled by the PDCCH.

’972 patent, 8:5-10. In effect, a “scheduling offset” is used by a transmitter to tell a receiver when to expect a data channel transmission.

34. The ’972 patent specification uses the term “leading time for beam switching” as follows:

The leading time for beam switching is, or may reflect, the minimum required time for a UE to set up its antenna panel(s) for providing an indicated RX/TX beam to receive or transmit data. For example, the leading time for beam switching may be the time period between the time the UE receives a command that leads to a change(s) in the Rx beam/antenna panel status and the time that the change(s) actually occurs.

’972 patent, 6:23-31. Moreover, “[e]ach antenna panel status [of a UE] may have its own leading time value.” ’972 patent, 9:10-11.

35. The ’972 patent recognizes that “[i]f the scheduling offset of a DL/UL RSs/channel reception/transmission cannot fulfill the leading time requirement, the UE may not be able to transmit/receive the RSs/channel successfully.” ’972 patent, 9:2-6. Thus, for this reason, “the UE may receive a scheduling offset value from

the BS. ... If the time duration indicated by the scheduling offset value is less than the leading time duration indicated by a selected leading time value, the UE may further determine that the scheduling offset value is invalid.” ’972 patent, 17:34-42. In other words, if a scheduling offset value (indicating a time at which a PDSCH will be transmitted) is less than the appropriate leading time value – reflecting the time it takes a UE having at least one antenna panel to switch to an indicated beam for receiving the PDSCH – the UE will not have enough time to adjust its antenna panel status to receive before the PDSCH arrives and therefore data may not be received by the UE correctly. The ’972 patent specification does not provide any further explanation of how a UE copes with a scheduling offset being “invalid.”

VI. PROSECUTION HISTORY OF THE ’972 PATENT

36. The application that led to the ’972 patent was filed on July 15, 2019, claiming the benefit of U.S. App. No. 62/699,465, filed on July 17, 2018. A non-final rejection was issued on August 28, 2020, in which the original independent claims were rejected, but certain dependent claims were indicated as allowable, including dependent claim 16. Ex.1002, 195-208. In response, Applicant amended claim 1 to include the allowable subject matter of claim 16, and amended other independent claims in a similar manner. Ex.1002, 183-193. For example, the Response states “Applicant has amended independent claim 1 to incorporate the

allowable subject matter in claim 16, and amended independent claim 17 to incorporate the allowable subject matter in claim 32.” Ex.1002, 192. Exemplary claim 1 was amended as follows.

1. (Currently Amended) A wireless communication device comprising:
a plurality of antenna panels;
a processor coupled to the plurality of antenna panels and configured to:
maintain a plurality of leading time values, ~~wherein~~ the plurality of leading time values ~~indicates~~ indicating a plurality of leading time durations;
receive an indicator for antenna panel status information from a base station (BS); ~~[[and]]~~
apply one of the plurality of leading time values to switch an antenna panel status of the plurality of antenna panels based on the indicator for antenna panel status information;
receive a scheduling offset value from the BS, the scheduling offset value comprising at least one of a K0 parameter for a Downlink (DL) channel and a K2 parameter for an Uplink (UL) channel; and
determine that the scheduling offset value is invalid, when a time duration indicated by the scheduling offset value is less than the leading time duration indicated by the selected leading time value.

Ex.1002, 184.

37. In response, a Notice of Allowance was issued on December 10, 2020. Ex.1002, 163. The Applicant thereafter submitted a response to the Notice of Allowance to “correct formalities.” Ex.1002, 161. Exemplary claim 1 was amended as follows.

1. **(Currently Amended)** A wireless communication device comprising:
a plurality of antenna panels;
a processor coupled to the plurality of antenna panels and configured to:
maintain a plurality of leading time values, the plurality of leading time values indicating a plurality of leading time durations;
receive an indicator for antenna panel status information from a base station (BS);
apply one of the plurality of leading time values to switch an antenna panel status of the plurality of antenna panels based on the indicator for antenna panel status information;
receive a scheduling offset value from the BS, the scheduling offset value comprising at least one of a K0 parameter for a Downlink (DL) channel and a K2 parameter for an Uplink (UL) channel; and
determine that the scheduling offset value is invalid, when a time duration indicated by the scheduling offset value is less than ~~[[the]]a~~ leading time duration indicated by the ~~selected~~ applied leading time value.

Ex.1002, 154. Thereafter, the '972 patent issued on April 6, 2021.

VII. CLAIM CONSTRUCTION

38. It is my understanding that in order to properly evaluate the '972 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 only one term, as indicated below, requires an explicit construction in this proceeding. The remaining terms of the challenged claims should be given their ordinary and customary meaning.

“an indicator for antenna panel status information” (Claims 1 and 15)

39. Exemplary claim 1 includes the following limitation: “*receive an indicator for antenna panel status information from a base station (BS).*” Claim 15 includes a similar limitation. The ’972 patent specification describes an indicator for antenna panel status broadly as any implicit or explicit indication of how many, or which, antenna panels are turned on or off. For example, the ’972 patent specification recites:

In some implementations of the present disclosure, the antenna panel status may be used for indicating, explicitly or implicitly, how many, or which, of the antenna panels of the UE are turned on (or active, or able to transmit and receive data), and/or how many, or which, of the antenna panels of the UE are turned off (or inactive, or not able to transmit and receive data).

Ex.1001, 10:4-10.

In addition, the indicator for antenna panel status may be implemented as any implicit/explicit data structure.

Ex.1001, 14:53-55.

40. These explanations specify that the indicator for antenna panel status information may be implemented as any implicit or explicit data structure that implicitly or explicitly indicates how many, or which, of the antenna panels of the UE are turned on (or active, or able to transmit and receive data), and/or how many, or which, of the antenna panels of the UE are turned off (or inactive, or not

able to transmit and receive data). Accordingly, “*an indicator for antenna panel status information*” is construed as “any implicit or explicit indication of how many, or which, antenna panels are turned on or off.”

VIII. IDENTIFICATION OF HOW THE CLAIMS ARE UNPATENTABLE

41. I have been asked to provide my opinion as to whether the Challenged Claims of the '972 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 '972 patent.

42. 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 '972 patent.

43. 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.

A. Ground 1: Claims 1, 2, 9-12, 14, 15, 16, 23-26, and 28 are obvious under 35 U.S.C. § 103 in view of Xi

1. Summary of Xi

44. Xi refers to U.S. Patent Pub. No. 2020/0288479, which was filed on November 15, 2018. I understand that Xi claims priority to multiple provisional

application filings, including U.S. Provisional App. No. 62/652,805 (Ex.1008, referred to herein as “Xi-Provisional”), filed on April 4, 2018. I also understand that in order to claim the benefit of Xi-Provisional, the subject matter relied upon in Xi must have been described in Xi-Provisional. Accordingly, I have been asked to provide a table comparing the disclosures of Xi that are relied on in the Petition and my declaration with the corresponding disclosures of Xi-Provisional. This table is included below in Section IX. Because the disclosures in Xi that I (and Petitioner) rely on were previously described in Xi-Provisional, I understand that Xi is entitled to claim the benefit of Xi-Provisional and therefore qualifies as prior art as of the filing date of the Xi-Provisional of April 4, 2018, which is before the earliest possible priority date of the ’972 patent of July 17, 2018. For convenience, I provide dual citations to Xi and Xi-Provisional herein.

45. Xi discloses a mobile wireless communication device that it refers to as a wireless transmit/receive unit (WTRU), such as “WTRUs 102a, 102b, 102c, 102d” in Figure 1A. Xi, [0021]; Xi-Provisional, [0034].

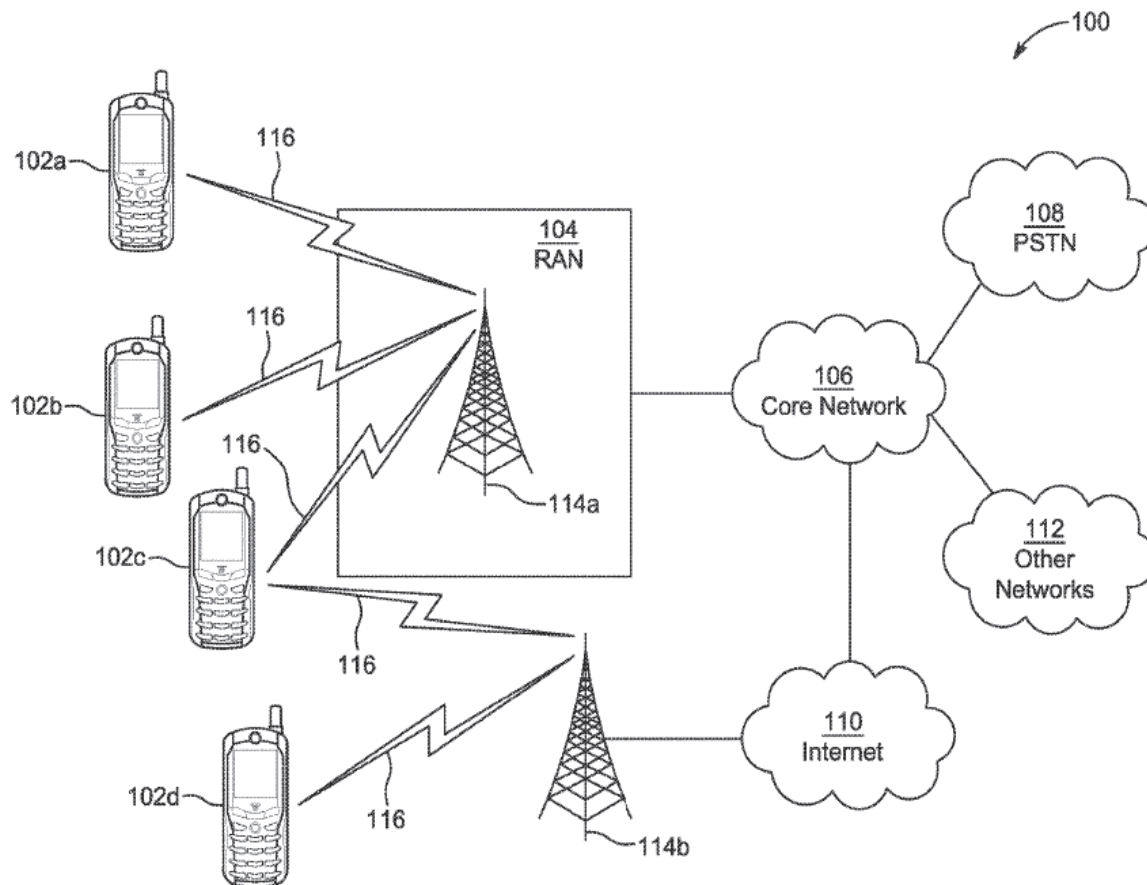


FIG. 1A

Xi, Figure 1A; Xi-Provisional, Figure 1A

46. Xi's WTRU includes multiple antenna panels, each having a number of antenna elements. Xi, [0077] ("FIG. 2 is diagram of an example of a ... WTRU antenna model 200. A massive antenna model 202 may be configured as M_g antenna panels per vertical dimension and N_g antenna panels per horizontal dimension."); Xi-Provisional, [0073]-[0074].

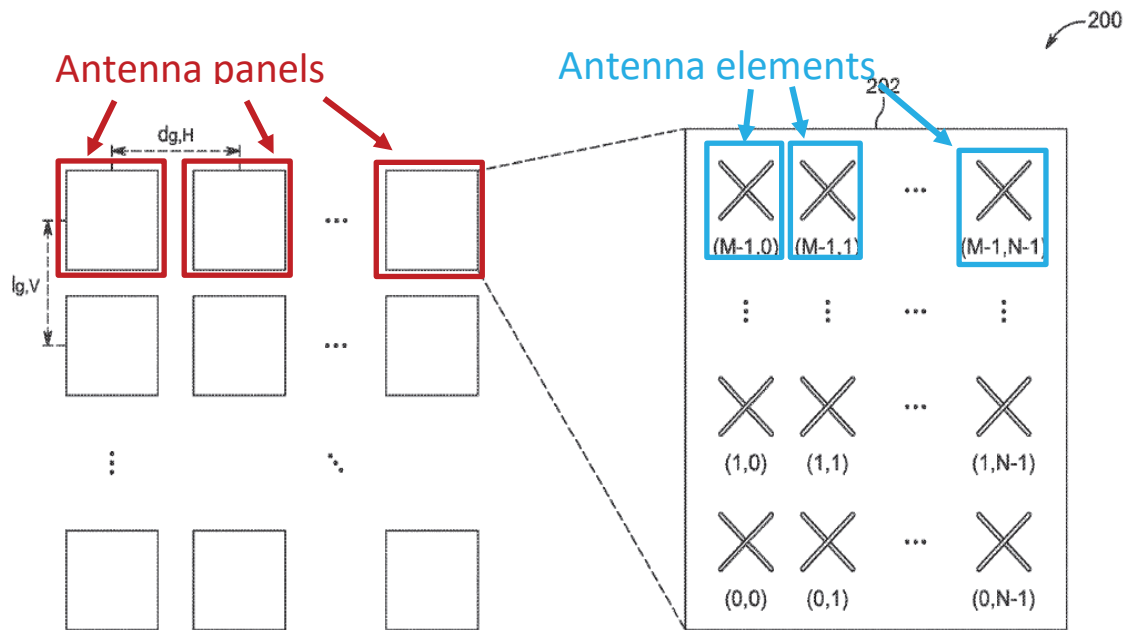


FIG. 2

Xi, Figure 2 (annotated in color); Xi-Provisional, Figure 2

47. Xi describes the use of an estimated time period (termed “threshold K”) for a WTRU to switch antenna beams. Xi, [0089] (“Threshold K may also be a value of estimated time duration for a WTRU performing ... beam switching, or the like if a new Rx beam is needed.”); Xi-Provisional, [0083]-[0084]. Xi also discloses configuring a WTRU with multiple values of the threshold K, and the WTRU may select from one of multiple values, depending on WTRU operation or WTRU state. Xi, [0094] (“The network may also configure a WTRU with several values of threshold K and the WTRU may select or determine a value of threshold K based on network configurations.”); Xi-Provisional, [0089]; Xi [0095] (“the ...

different threshold K value may be configured to a WTRU based on WTRU capability, WTRU operation, WTRU states, current WTRU numerology, custom WTRU settings, or the like.”); Xi-Provisional, [0091].

48. Xi discloses downlink control information (DCI), which is transmitted on a physical downlink control channel (PDCCH). Xi, [0107] (“...after decoding the DCI from the received PDCCH.”); Xi-Provisional, [0106]. The DCI may include a “scheduling offset” for used for scheduling transmissions on the PDSCH. Xi, [0109] (“If the scheduling offset of a corresponding NR-PDSCH, that may be indicated by the scheduling assignment DCI...”); Xi-Provisional, [0111].² According to Xi, a TCI indicator within the DCI may also indicate the beam used for the PDSCH. Xi, [0083], [0086]; Xi-Provisional, [0078], [0081]. Thus, in summary, Xi discloses a WTRU having multiple antenna panels that receives DCI

² Consistent with the usage in the '972 patent, the term “scheduling offset” is a term of art that was generally understood by POSITAs as related to the time offset between a scheduling assignment DCI message and the corresponding PDSCH allocation scheduled by the DCI message. *See, e.g.*, Xi, [0087] (“a scheduling offset or scheduling delay of the corresponding NR-PDSCH allocation”); [0090] (“scheduling offset or time offset for the reception or demodulation of NR-PDSCH”); Xi-Provisional, [0082], [0084].

from a base station, the DCI including both a beam indication and a scheduling offset for scheduling and receiving a subsequent message on the PDSCH.

49. Xi describes comparing the scheduling offset value to the threshold K , which is a time required to switch to the beam indicated by the DCI. For example, Xi notes that if the scheduling offset value (indicating when a PDSCH will be received) is greater than the time required for beam switching (threshold K), then the WTRU is able to use the beam indicated by the DCI. Xi, [0109]; Xi-Provisional, [0111]. In other words, the WTRU has enough time to switch to the indicated beam before the PDSCH arrives (at a time offset from the DCI indicated by the scheduling offset value).

50. However, Xi notes that if the scheduling offset value is less than the time required for beam switching (threshold K), then the WTRU cannot use the beam indicated by the DCI to receive the PDSCH in time, so that some other rule must be followed. Otherwise, PDSCH information that arrives at the WTRU before the time needed for WTRU beam switching has elapsed may be lost. Xi, [0109] (“If the scheduling offset ... is smaller than the threshold K , the WTRU may apply a suitable Rx beam from the starting symbol of the scheduled NR-PDSCH. This operation may avoid loss of NR-PDSCH symbols scheduled before the threshold K .”); Xi-Provisional, [0111]. That is, Xi’s WTRU determines that the scheduling offset value is not usable such that the WTRU is unable to switch its beam quickly

enough to the indicated beam to satisfy receiving the PDSCH at the time indicated by the scheduling offset.

51. In the event that a WTRU does not have enough time to switch to the indicated beam, Xi then provides several alternatives for selecting a “suitable Rx beam” that does not involve switching to the beam indicated in the DCI, including the use of a “preconfigured beam” or a “default beam,” Xi, [0110], or a beam “based on pre-defined rules,” Xi, [0113]; Xi-Provisional, [0112]-[0113].

52. Although Figure 4 of Xi is not included in Xi-Provisional, Figure 4 is useful here for tutorial purposes to summarize and illustrate the teachings of Xi above. (Figure 4 is not relied upon in the application of Xi to the claims.) In the example labeled 410, the scheduling offset of the first slot is greater than “Thres” (or threshold K), so the WTRU has enough time to switch to the “Indicated Beam.” However, for the example labeled 402, the scheduling offset for every slot is less than “Thres,” so the WTRU does not have enough time to switch to the “Indicated Beam” and should instead use a “Default Beam” to receive in this example. The example labeled as 406 is an intermediate situation in which the WTRU does not have enough time to switch to the “Indicated Beam” in the first slot (and hence must use a “Default Beam” for that slot) but does have enough time to switch beams by the time of the second slot.

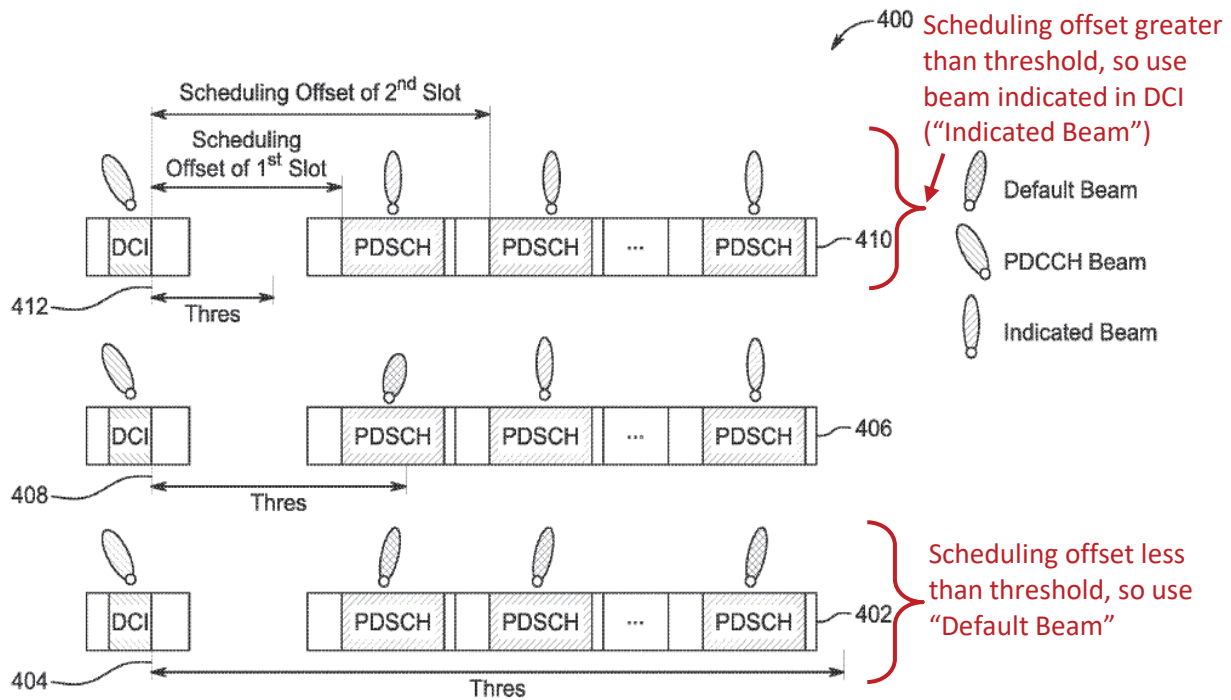


FIG. 4

Xi, Figure 4

2. Claim 1

[1.0] *A wireless communication device comprising:*

53. Xi discloses a wireless transmit/receive unit (WTRU), which is an example “*wireless communication device*,” as claimed. For example, Xi discloses:

As shown in FIG. 1A, the communications system 100 may include wireless transmit/receive units (WTRUs) 102a, 102b, 102c, 102d...

Each of the WTRUs 102a, 102b, 102c, 102d may be any type of device configured to operate and/or communicate in a wireless environment.

Xi, [0021]; Xi-Provisional, [0034].

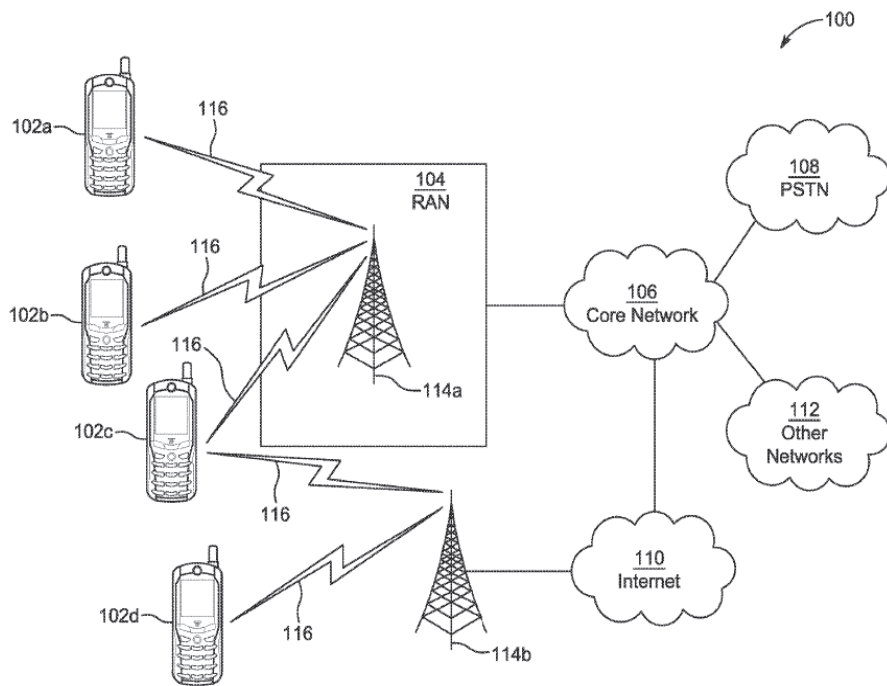


FIG. 1A

Xi, Figure 1A; Xi-Provisional, Figure 1A

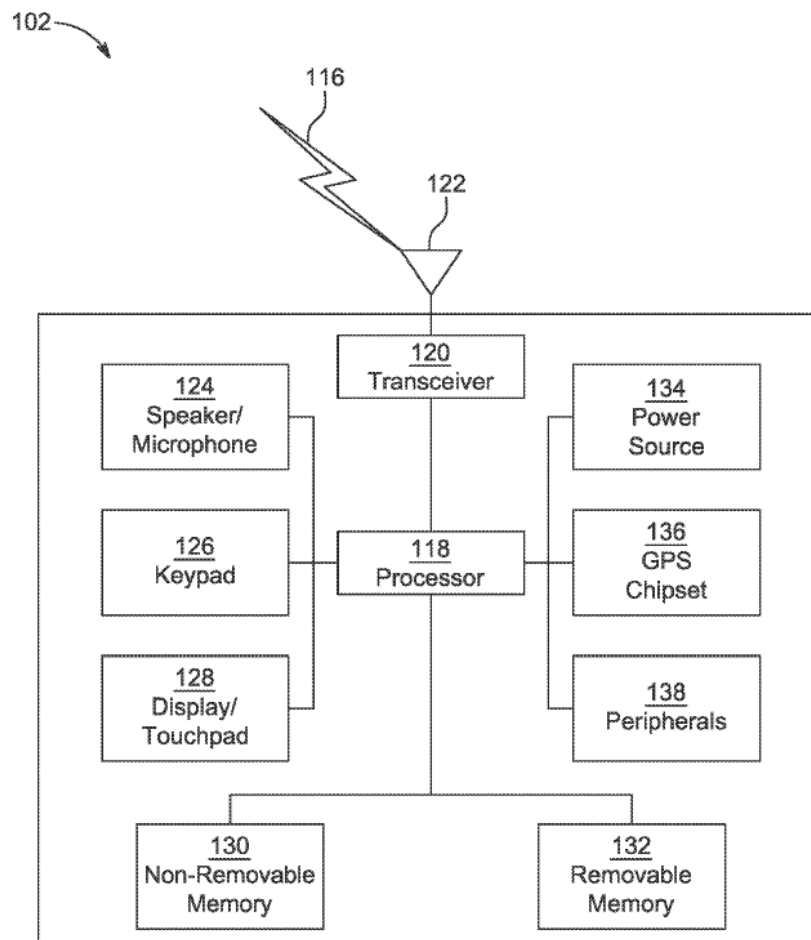


FIG. 1B

Xi, Figure 1B; Xi-Provisional, Figure 1B

54. Thus, Xi's WTRU is an example of a “*wireless communication device*.”

[1.1] *a plurality of antenna panels*;

55. Xi's WTRU may include multiple antenna panels (“*a plurality of antenna panels*”), thereby disclosing claim element [1.1]:

FIG. 2 is diagram of an example of a transmission reception point (TRP) and WTRU antenna model 200. A massive antenna model 202

may be configured as M_g antenna panels per vertical dimension and N_g antenna panels per horizontal dimension. Each antenna panel may be configured with N columns and M rows of antenna elements with or without polarization.

Xi, [0077]; Xi-Provisional, [0073]-[0074].

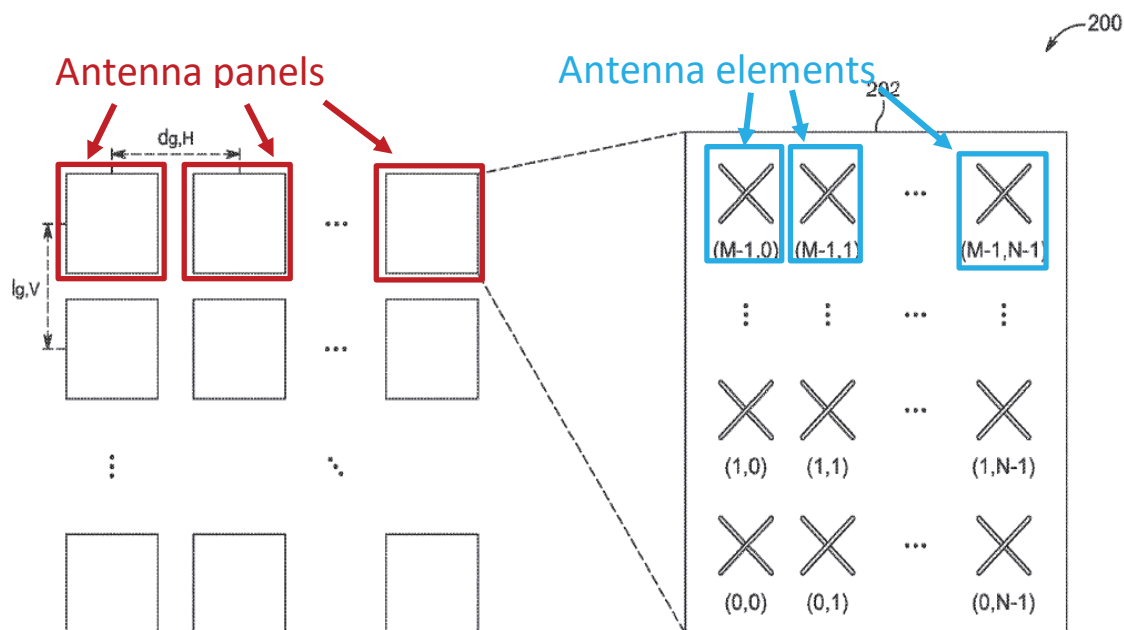


FIG. 2

Xi, Figure 2 (annotated in color) ; Xi-Provisional, Figure 2

[1.2] *a processor coupled to the plurality of antenna panels and configured to:*

56. Xi discloses claim element [1.2].

57. Xi discloses a WTRU having a processor coupled to a transmit/receive element 122: “As shown in FIG. 1B, the WTRU 102 may include a processor 118, a transceiver 120, a transmit/receive element 122...”

Xi, [0034]; Xi-Provisional, [0031].

The processor 118 may be coupled to the transceiver 120, which may be coupled to **the transmit/receive element 122**. While FIG. 1B depicts the processor 118 and the transceiver 120 as separate components, it will be appreciated that the processor 118 and the transceiver 120 may be integrated together in an electronic package or chip.

Xi, [0035]; Xi-Provisional, [0032]. The transmit/receive element 122 may include multiple antennas for implementing MIMO technology:

Although the transmit/receive element 122 is depicted in FIG. 1B as a single element, the WTRU 102 may include any number of transmit/receive elements 122. More specifically, the WTRU 102 may employ MIMO technology. Thus, in one embodiment, the WTRU 102 may include two or more transmit/receive elements 122 (e.g., multiple antennas) for transmitting and receiving wireless signals over the air interface 116.

Xi, [0037]; Xi-Provisional, [0034]. Thus, Xi discloses a WTRU with a processor (“*a processor*”) that couples to multiple antennas (e.g., multiple transmit/receive elements 122). And, as shown in Figure 2, which illustrates a “WTRU antenna model 200,” the antennas are organized into multiple antenna panels (“*the plurality of antenna panels*”). Thus, Xi discloses or renders obvious “*a processor coupled to the plurality of antenna panels.*”

[1.3] maintain a plurality of leading time values, the plurality of leading time values indicating a plurality of leading time durations;

58. First, Xi discloses the use of an estimated time duration (termed “threshold K”) for switching beams (“*leading time value*”/“*leading time duration*”).

59. Xi recognizes the use of a **“threshold K, which may be an estimated time duration that the WTRU needs to finish ... beam switching from a current Rx beam to a new Rx beam, or the like. Threshold K may also be a value of estimated time duration for a WTRU performing ... beam switching, or the like if a new Rx beam is needed.”** Xi, [0088]-[0089]; Xi-Provisional, [0083]-[0084].

60. Thus, the “threshold K,” the estimated time for beam switching if a new receive beam is needed, is a “*leading time value*,” indicating “*a leading time duration*.”

61. Second, Xi also discloses a WTRU that maintains multiple values of the threshold K:

In certain configurations, threshold K may be based on WTRU capability when one or more candidate values of threshold K are available.

Xi, [0084]; Xi-Provisional, [0079].

In certain configurations, **a WTRU may be configured with one or more values of threshold K.** ... For example, a WTRU may be capable of multiple types of service, such as URLLC or eMBB, simultaneously

or alternately where one or more thresholds K may be accordingly configured for multiple services. Each type of service may have similar or different threshold K values.

Xi, [0092]; Xi-Provisional, [0087].

Threshold K may be configured, selected, determined, calculated, or the like by a network device, gNB, TRP, WTRU, mobile device, or the like.

Xi, [0093]; Xi-Provisional, [0088].

The network may also **configure a WTRU with several values of threshold K** and the WTRU may select or determine a value of threshold K based on network configurations.

Xi, [0094]; Xi-Provisional, [0089].

In addition, the similar or different threshold K value may be configured to a WTRU based on WTRU capability, WTRU operation, WTRU states, current WTRU numerology, custom WTRU settings, or the like.

Xi, [0095]; Xi-Provisional, [0091].

62. Furthermore, Xi explains that the threshold K can depend on the “WTRU processing time for beam switching, ... number of panels equipped and used simultaneously/non-simultaneously, ... or the like ”:

Threshold K may depend on WTRU capability... WTRU capabilities may include ... WTRU processing time for beam switching, ... number of panels equipped and used simultaneously/non-simultaneously, fixed Rx beam configurations, or the like.

Xi, [0090]; Xi-Provisional, [0084]. Thus, a threshold K (a “*leading time value*,”

indicating “*a leading time duration*”) can depend on the beam switch time and number of antenna panels used in a WTRU, or may more generally depend on a “WTRU operation” or “WTRU state,” such as current antenna configuration/beam usage.

63. In addition, Tables 2 and 3 of Xi present different values of threshold K, depending on component carrier (CC), subcarrier spacing (SCS), and bandwidth part (BWP) being used in a given geography in the wireless system. Xi, [0097] (“Table 2 and Table 3 are examples of determining or selecting threshold K.”), [0099]; Xi-Provisional, [0093].

TABLE 2

Beam Indication Latency	Units	60 kHz	120 kHz	60 kHz	120 kHz
		SCS	SCS	SCS	SCS
		CC1/BWP1		CC2/BWP2	
Low	Symbols	Value 1	Value 4	Value 7	Value 10
Latency	or Slots				
Medium	Symbols	Value 2	Value 5	Value 8	Value 11
Latency	or Slots				
High	Symbols	Value 3	Value 6	Value 9	Value 12
Latency	or Slots				

TABLE 3

Beam Indication	Units	60 kHz	120 kHz	60 kHz	120 kHz
		SCS	SCS	SCS	SCS
Latency		CC1/BWP1		CC2/BWP2	
Low	Sym-	Value 13	Value 16	Value 19	Value 22
Latency	bols or Slots				
Medium	Sym-	Value 14	Value 17	Value 20	Value 23
Latency	bols or Slots				
High	Sym-	Value 15	Value 18	Value 21	Value 24
Latency	bols or Slots				

64. In summary, Xi notes the number of variables that may affect beam switching time, including component carrier, subcarrier spacing, bandwidth part, number of beam configurations, and number of panels. Thus, it would have been obvious that there are multiple values of beam switching time (threshold K) maintained by the WTRU.

65. Thus, Xi discloses a WTRU being configured with (thereby “maintain[ing]”) multiple values of threshold K (“*plurality of leading time values indicating a plurality of leading time durations*”), each of which is an estimated duration of time for performing beam switching, thereby disclosing or rendering obvious “*maintain a plurality of leading time values, the plurality of leading time values indicating a plurality of leading time durations.*”

66. The ’972 patent defines “*leading time duration*” or “*leading time value*” as a time required for a mobile station with at least one antenna panel to switch beams after receiving a beam switch command:

Issues related to the leading time for beam switching may affect the power consumption. The leading time for beam switching is, or may reflect, the minimum required time for a UE to set up its antenna panel(s) for providing an indicated RX/TX beam to receive or transmit data. For example, the leading time for beam switching may be the time period between the time the UE receives a command that leads to a change(s) in the Rx beam/antenna panel status and the time that the change(s) actually occurs.

'972 patent, 6:23-31; *see also* 8:65-9:2. Furthermore, "[t]he antenna panels described herein may be referred to antenna arrays or antenna ports. The antenna arrays may include a number of physical antennas, while the antenna ports may not correspond to physical antennas, but rather may be logical entities distinguished by their channel models." '972 patent, 7:6-11.

67. Thus, the "leading time value," or "leading time duration," for beam switching in the '972 Patent is the time required to for a mobile station with at least one antenna panel to switch beams after receiving a command to do so. I have been informed that the patent owner proposes that no construction of "leading time [value[s]]/[duration[s]]" is necessary in district court, alleging that petitioner's understanding is unduly limited to a specific embodiment and arguing for a broader understanding of the term. Here, I have presented my understanding of the term "leading time [value[s]]/[duration[s]]" to the extent necessary to resolve the application of the prior art to the claims. Regardless of whether my understanding

represents a definition or merely an example of the term, the prior art renders the claim obvious for the same reasons. In other words, the dispute in district court is irrelevant for this proceeding because the prior art renders the claims obvious even under my narrower understanding.

[1.4] *receive an indicator for antenna panel status information from a base station (BS);*

68. Xi discloses or renders obvious claim element [1.4].

69. Xi discloses downlink control information (DCI), which is transmitted on a physical downlink control channel (PDCCH), and the DCI may include a “scheduling offset” for used for scheduling the PDSCH:

A WTRU may receive the scheduling offset or time offset information for PDSCH reception or demodulation after decoding the DCI from the received PDCCH.

Xi, [0107]; Xi-Provisional, [0106].

If the scheduling offset of a corresponding NR-PDSCH, that may be indicated by the scheduling assignment DCI...

Xi, [0109]; Xi-Provisional, [0111]. Consistent with the usage in the '972 patent,³ the term “scheduling offset” is a term of art that was generally understood by

³ “The scheduling offset, in some implementations, may be a time duration starting from the end of the last symbol of a Physical Downlink Control Channel (PDCCH) to the beginning of the first symbol of a PDSCH.” '972 patent, 6:46-49.

POSITAs as related to the time offset between a scheduling assignment DCI message and the corresponding PDSCH message scheduled by the DCI message. *See, e.g.,* Xi, [0087] (“a scheduling offset or scheduling delay of the corresponding NR-PDSCH allocation”); [0090] (“scheduling offset or time offset for the reception or demodulation of NR-PDSCH”); Xi-Provisional, [0082], [0084].

70. The DCI may be used to schedule the PDSCH, e.g., using a Transmission Configuration Indicator (TCI). *See* Xi, [0107] (above) and [0084] (“For timing of beam indication for NR-PDSCH, when spatial QCL is configured or indicated, **a present TCI field may be located in the associated DCI for NR-PDSCH scheduling** independent of same-slot scheduling or cross-slot scheduling.”); Xi-Provisional, [0106], [0079].

71. According to Xi, the TCI indicator within the DCI may also indicate the beam used for the PDSCH.

NR (New Radio/5G) may utilize dynamic beam indication for PDSCH that may need an N-bit indicator state or TCI state field in the DL-related DCI field for PDSCH beam indication. Xi, [0083]; Xi-Provisional, [0078].

A DL beam indication for NR-PDSCH may be included in an N-bit TCI field in a DCI that utilizes a spatial QCL reference to a DL RS... Xi, [0086]; Xi-Provisional, [0081]. Xi’s multi-panel WTRU therefore receives a *beam indication* from a base station in a TCI indicator. Likewise, the ’972 patent

states that “the indicator for antenna panel status information may be contained in a TCI state ID indicated by the BS.” ’972 patent, 10:64-11:1.

72. A POSITA would have understood that a WTRU having multiple antenna panels, such as in Xi, provides many degrees of freedom for beamforming, such as different beam directions and beamforming gains, thereby providing increased coverage, throughput, and reliability. In other words, antenna panels, each consisting of multiple antenna elements, can generate multiple antenna beam patterns per panel for beamforming. Tutorial articles on multi-panel devices confirm this understanding. *See, e.g.*, Ex.1009 (“Multi-Panel MIMO in 5G”), p. 56 (“A large number of antenna elements bring extra degrees of freedom for increasing the throughput and considerable beamforming gains for improving the coverage. In practice, a large number of antenna elements can be assembled into multiple antenna panels for the purpose of cost reduction and power saving. Multi-panel MIMO is expected to become promising for millimeter-wave massive MIMO systems.”). The ’972 patent itself, in the “Background” section, recognizes the same principles. *See, e.g.*, ’972 patent, 1:25-31 (“Multi Input Multi Output (MIMO) is one of the key features in the next generation wireless communication systems. With the MIMO technology, a number of antenna panels at the transceiver/receiver can bring extra degrees of freedom to increase the data throughput, beamforming gain and coverage.”).

73. Xi's beam indicator (conveyed via a TCI value) is *an indicator for antenna panel status information* because it implicitly indicates or specifies which panel(s) in Xi's WTRU to use. In multi-panel WTRUs, a beam is associated with one or more specific panels, as was well-known in the art. *See, e.g.*, Ex.1016, 9:42-46 ("To build gNB 170 awareness of which panels UE 110 would use to receive certain transmit beams, the UE 110 may provide gNB 170 with beam reports indicating, with panel tag, which panel is used for measuring certain beam management (BM) source RS."); Ex.1017, [0051]; Ex.1015, Abstract ("Each TCI-state corresponds to a radio beam and also corresponds to an antenna panel."). .

74. And because a beam is associated with a panel, a POSITA would have understood that a TCI beam indicator communicated to a multi-panel WTRU implicitly indicates a particular antenna panel to use. Ex.1015, Abstract ("Each TCI-state corresponds to a radio beam and also corresponds to an antenna panel."), [0088] ("A given TCI may lead to a UE using a specific panel for reception."), [0089] ("The UE can then determine, based on the configuration and active TCI state, which TX/RX panels it is allowed to deactivate/turn off, for instance, for power saving purposes."), [0120], [0123], 28 (claims 1, 2, and 5)). When a WTRU uses an antenna panel for a beam, the panel is turned on. Since remaining unused panels are not needed for communication, it would have been understood or obvious to a POSITA that these panels can be turned off. *See, e.g.*, Ex.1007, [3]

("[F]or power saving purpose it would be preferable to switch off panels that are not needed e.g. for data transmission and/or reception."). Accordingly, an indication of a specific beam is an implicit indication of a specific antenna panel or panels in Xi's multi-panel WTRU that is in use and therefore turned on. Xi's beam indicator received from the base station informing the WTRU of which beam to use (turn on) is thus an example of "*an indicator for antenna panel status information,*" as the claim term is properly understood ("any implicit or explicit indication of how many, or which, antenna panels are turned on or off").

75. Furthermore, the concept of implicit signaling in wireless communications was well-known to a POSITA. Implicit signaling generally refers to a linkage between an explicitly signaled quantity and a second quantity such that a receiver that receives or knows the explicitly signaled quantity can determine the second quantity from the explicitly signaled quantity. For example, two quantities may be linked via an implicit relationship. In the following example, so-called power states and beam management (BM) states in a wireless device are so linked:

As noted above, each of the power states 11-14 is linked to or associated with a different one of the BM states 21-24, for example, **via an implicit relationship.**

Deenoo, [0174]. In another example, a feedback mode is linked to an assigned resource block (RB) index, so that if a wireless device knows the RB index, the device implicitly knows the feedback mode, and vice versa:

2) Implicit Signaling Method Using Uplink Assigned RB Index

A feedback mode can be indicated/identified using index functions of UL RBs allocated for aperiodic PUSCH feedback transmission. That is, **information indicating the feedback mode may be linked with an RB index for PUSCH feedback transmission.**

U.S. Patent No. 9,432,977, 15:45-51. In the same way, it would have been obvious that a multi-panel WTRU that receives a beam indication would have implicitly known which panel or panels to use for the indicated beam, particularly since an indicated beam is necessarily generated by antennas in the WTRU's antenna panels.

76. In summary, Xi's teaching of a WTRU having multiple antenna panels (per the analysis of [1.2] and [1.3]) and Xi's teaching of WTRU receiving DCI from a base station having a beam indication for receiving (and a scheduling offset for scheduling) a subsequent PDSCH, disclose or render obvious "*receive an indicator for antenna panel status information from a base station (BS).*"

[1.5] apply one of the plurality of leading time values to switch an antenna panel status of the plurality of antenna panels based on the indicator for antenna panel status information;

77. Xi renders obvious claim element [1.5] because it teaches that its WTRU selects and applies one of the available values of the threshold K to determine whether to switch to the panel implicitly indicated by the beam indicator (*apply one of the plurality of leading time values to switch an antenna panel status*

of the plurality of antenna panels) based on the TCI beam indicator (*based on the indicator for antenna panel status information*). In more detail, Xi teaches a WTRU having multiple antenna panels and that receives a beam indication from a base station for receiving (and, in the same message, a scheduling offset for scheduling) a subsequent PDSCH message. The beam indicator is used (1) to implicitly indicate which antenna panel to use and (2) to determine which threshold K (*leading time value*) to use (because the particular threshold K used is based on which beam is indicated in the beam indicator).

78. As explained in the analysis of claim element [1.3], Xi discloses that the threshold K (*leading time value*) is selected or determined by a WTRU, Xi, [0092]-[0094], Xi-Provisional, [0087]-[0089], and the threshold K depends on WTRU processing time for beam switching and the number of panels equipped and used simultaneously or non-simultaneously, Xi, [0088]-[0090], Xi-Provisional, [0083]-[0084]. And, as explained in [1.4], Xi teaches that its WTRU receives a beam indication that implicitly indicates which antenna panel to use (*indicator for antenna panel status information*).

79. In more detail, Xi explains that a WTRU may be configured with multiple values of threshold K (with each threshold indicating a time duration for beam switching), with the values depending on a variety of factors. **“Threshold K may depend on WTRU capability... WTRU capabilities may include ...**

WTRU processing time for beam switching, ... number of panels equipped and used simultaneously/non-simultaneously, ... or the like.” Xi, [0090];

Xi-Provisional, [0084]. As a numerical example, Xi recognizes that the time to implement an indicated beam depends on whether a beam indication indicates whether a different beam is needed or not. Xi, [0104] (“Beam switching time may be equal to 0 if no beam switching is needed or a non-zero value if beam switching is needed.”); Xi-Provisional, [0103]. In other words, at any given time, the value used for threshold K can depend on the processing time for beam switching and antenna panel usage. Thus, it would have been obvious, based on Xi’s teachings, for a WTRU to apply a different value of threshold K based on the processing time for beam switching if a beam switch involves switching between antenna panels or changing which panels are in use.

80. Xi teaches that if the scheduling offset value is less than the threshold K (applied “*leading time value*”), then the WTRU cannot use the beam indicated by the DCI, so that some other rule must be followed:

If the scheduling offset of a corresponding NR-PDSCH, that may be indicated by the assignment DCI, is smaller than the threshold K, the WTRU may apply a suitable Rx beam from the starting symbol of the scheduled NR-PDSCH. This operation may avoid loss of NR-PDSCH symbols scheduled before the threshold K.

Xi, [0109]; Xi-Provisional, [0111]. Xi provides several alternatives for selecting a

“suitable Rx beam” that do not involve switching to the beam indicated in the DCI, including the use of a “preconfigured beam” or a “default beam,” Xi, [0110]; Xi-Provisional, [0112], or a beam “based on pre-defined rules,” Xi, [0113]; Xi-Provisional, [0113]. Thus, in this example, Xi describes applying a threshold K to determine whether to use the beam/panel indicated by the beam indication, and then switching the beam/panel accordingly, thereby rendering obvious claim element [1.5].

[1.6] receive a scheduling offset value from the BS, the scheduling offset value comprising at least one of a K0 parameter for a Downlink (DL) channel and a K2 parameter for an Uplink (UL) channel; and

81. As explained in the analysis of [1.3] and the Summary of Xi (Section VIII.A.1), Xi’s DCI message, received from a BS, includes a scheduling offset value (*receiving a scheduling offset value from the BS*) for receiving a PDSCH (*a downlink (DL) channel*), see Xi, [0107], [0109]; Xi-Provisional, [0106], [0111], thereby disclosing or rendering obvious claim element [1.6]. For example, Xi recites:

If the scheduling offset of a corresponding NR-PDSCH, that may be indicated by the assignment DCI, is smaller than the threshold K... Xi, [0109]; Xi-Provisional, [0111]. (And as explained in [1.4], the DCI used for scheduling can also include a TCI field that indicates the beam used for PDSCH.)

82. In the ’972 specification, the term “K0 parameter” is a generic name given to the scheduling offset value for a downlink channel, such as PDSCH. For

example, the '972 Patent uses the term "K0 value" as follows:

On the other hand, the PDSCH transmission may be associated with another scheduling offset also for the normal leading time case (e.g., a K0 value for determining a PDSCH reception offset).

'972 Patent, 17:50-52.

An illustrative example (Example 1-1) will now be provided, where the **scheduling offset value (e.g., K0 value) for PDSCH reception** may be selected based on an indicator for antenna panel status (e.g., contained in a TCI state) from the BS.

'972 Patent, 20:67-21:3. Thus, an example of a "K0 parameter" in the '972 Patent is a scheduling offset value for PDSCH reception, which is what Xi discloses.

83. Further, the '972 Patent defines the expression "at least one of A and B" as follows: "The expression 'at least one of A, B and C' or 'at least one of the following: A, B and C' means 'only A, or only B, or only C, or any combination of A, B and C.'" '972 Patent, 3:62-65. Thus, only one of "*at least one of a K0 parameter for a Downlink (DL) channel and a K2 parameter for an Uplink (UL) channel*" needs to be disclosed to satisfy the claim element.

84. Accordingly, Xi's DCI received from a base station that includes a scheduling offset value for receiving a PDSCH discloses or renders obvious "*receive a scheduling offset value from the BS, the scheduling offset value comprising at least **one** of a K0 parameter for a Downlink (DL) channel and a K2 parameter for an Uplink (UL) channel.*"

[1.7] *determine that the scheduling offset value is invalid, when a time duration indicated by the scheduling offset value is less than a leading time duration indicated by the applied leading time value.*

85. As also explained in the analysis of claim element [1.5], Xi describes comparing the scheduling offset value (*scheduling offset value*) to the applied threshold K, which is a time required to switch to the beam indicated by the DCI (*a leading time duration indicated by the applied leading time value*). Xi teaches that if the scheduling offset value is less than the time required for beam switching (threshold K), then the WTRU cannot use the beam indicated by the DCI, so some other rule must be followed. Otherwise, PDSCH information received before the time needed for beam switching has elapsed may be lost:

If the scheduling offset of a corresponding NR-PDSCH, that may be indicated by the assignment DCI, is smaller than the threshold K, the WTRU may apply a suitable Rx beam from the starting symbol of the scheduled NR-PDSCH. This operation may avoid loss of NR-PDSCH symbols scheduled before the threshold K.

Xi, [0109]; Xi-Provisional, [0111]. That is, Xi's WTRU determines that the scheduling offset value is not usable (*invalid*) if it is less than a threshold K, such that the WTRU is not able to switch its beam quickly enough to the indicated beam to receive the PDSCH at the time indicated by the scheduling offset.

86. Otherwise, if the base station had scheduled the data message in the PDSCH using a sufficiently large scheduling offset, the WTRU would have had

enough time to switch beams:

If the scheduling offset of a corresponding NR-PDSCH, that may be indicated by the scheduling assignment DCI, is equal or bigger than the threshold K, NR-PDSCH may use the beam or spatial QCL assumption indicated by the N-bit TCI in the assignment DCI.

Xi, [0109]; Xi-Provisional, [0111]. In other words, the WTRU has enough time to switch to the indicated beam before the PDSCH arrives (at a time offset from the DCI indicated by the scheduling offset value).

87. Unlike the '972 patent specification, which does not specify how a UE copes with this situation beyond determining that a scheduling offset value is “invalid,” Ex.1001, 17:38-42, Xi further provides several alternatives for selecting a “suitable Rx beam” that does not involve switching to the beam indicated in the DCI, including the use of a “preconfigured beam” or a “default beam,” Xi, [0110], or a beam “based on pre-defined rules,” Xi, [0113]; Xi-Provisional, [0112], [0113].

88. Thus, Xi discloses a WTRU determining that a time duration indicated by the scheduling offset value is less than the threshold K, which is the time required for beam switching to the indicated beam (*when a time duration indicated by the scheduling offset value is less than a leading time duration indicated by the applied leading time value*). Xi recognizes that if the WTRU tried to abide by the scheduling offset in this situation, information would be lost (the scheduling offset is “invalid”). For these reasons, Xi renders obvious claim

element [1.7].

3. Claim 2

The wireless communication device of claim 1, wherein the processor is further configured to:

[2.1] receive a timer from the BS; and

89. As discussed in the analysis of claim element [1.4], Xi discloses the use of a TCI indicator within a DCI message of a PDCCH to indicate the beam used for a subsequent PDSCH. As explained in Xi, a WTRU may use a beam for a given amount of time, indicated by a timer, so that the beam does not need to be indicated for every PDSCH.

A WTRU may use a semi-persistent beam, such as when a Tx or Rx beam for NR-PDSCH changes slowly or infrequently making indication of the beam in every scheduled NR-PDSCH unnecessary. As an example, a spatial QCL assumption or a beam sent to a WTRU at timeslot t1 may be reused by the WTRU to receive a plurality of subsequent scheduled NR-PDSCH allocations until a condition is satisfied. For low overhead, a spatial QCL assumption may be indicated to the WTRU by using DCI or TCI. ... Another condition may be a **timer** configured with each spatial QCL assumption.

Xi, [0112]; Xi-Provisional, [0116]. As recited above, the “timer [may be] configured with each spatial QCL assumption,” and the “spatial QCL assumption may be indicated to the WTRU using DCI or TCI.” As discussed extensively herein, DCI and TCI are control information transmitted by a base station and

received by a WTRI.

90. Further, Xi explicitly discloses receipt of a timer from a BS (in a DCI, a MAC-CE, or RRC message, which are transmitted by a base station):

A persistent duration may be related to WTRU speed and configured or **indicated as a certain period or a timer in a DCI, a MAC-CE message or signal, a RRC message**, or the like.

Xi, [0113]; Xi-Provisional, [0117].

91. Thus, Xi discloses a WTRU (having a processor) receiving a timer from a BS, wherein a beam is used until the timer expires, thereby rendering obvious [2.1].

[2.2] *switch the antenna panel status from a first antenna panel status to a second antenna panel status after the timer expires.*

92. As discussed in the analysis of claim element [1.4], it would have been understood or obvious that a beam indication transmitted to Xi's multi-panel WTRU would have explicitly or implicitly indicated one or more antenna panels to use for generating the antenna beam. In receiving a PDSCH using a beam indicated by DCI/TCI, Xi's multi-panel WTRU would have had "*a first antenna panel status.*"

93. When a timer expires, a "new spatial QCL assumption" may be used to "overwrite the old spatial QCL assumption":

Another condition may be a timer configured with each spatial QCL assumption. When the timer expires, spatial QCL assumptions may

become invalid. A new spatial QCL assumption may also be a condition indicated or configured that may directly overwrite the old spatial QCL assumption.

Xi, [0112]; Xi-Provisional, [0116]. Xi discloses that the “spatial QCL assumption” is equivalent to indicating a beam:

If the scheduling offset of a corresponding NR-PDSCH, that may be indicated by the scheduling assignment DCI, is equal or bigger than the threshold K, NR-PDSCH may use the **beam or spatial QCL assumption** indicated by the N-bit TCI in the assignment DCI.

Xi, [0109]; Xi-Provisional, [0111]. As discussed earlier, a beam would have been generated using one or more antenna panels in Xi’s multi-panel WTRU.

94. Accordingly, when Xi’s beam is switched after a timer expires, the multi-panel WTRU may switch to a different antenna panel (or set of panels), thereby disclosing or rendering obvious “*switch the antenna panel status from a first antenna panel status to a second antenna panel status after the timer expires.*”

4. Claim 9

The wireless communication device of claim 1, [9.1] wherein the indicator for antenna panel status information comprises a multiple-bit Information Element (IE), and the processor is further configured to:

95. As discussed in the analysis of claim element [1.4], an N-bit TCI indicator may indicate the beam for a PDSCH to a multi-antenna-panel WTRU. *See, e.g., Xi, [0083] (“NR (New Radio/5G) may utilize dynamic beam indication*

for PDSCH that may need an **N-bit indicator state or TCI state field in the DL-related DCI field for PDSCH beam indication.**”); Xi-Provisional, [0078]. Xi discloses that WTRU capabilities may include number of panels equipped and used simultaneously/non-simultaneously, and a WTRU may report this capability to a base station, such as a gNB or TRP. *See* Xi, [0090]; Xi-Provisional, [0084]. And, as further explained in the analysis of claim element [1.4], a POSITA would have understood that a WTRU having multiple antenna panels, such as in Xi, provides many degrees of freedom for beamforming, thereby providing increased coverage, throughput, and reliability.

96. Thus, Xi’s N-bit TCI, with $N > 1$, is an example “*multiple-bit Information Element (IE).*”

[9.2] *turn on a particular number of the plurality of antenna panels when the multiple-bit IE is set to a particular value.*

97. As explained in the analysis of [1.4], it would have been understood or obvious that a beam indication (in a “*multiple bit*” TCI, which is “*set to a particular value*” to indicate the beam) transmitted to Xi’s multi-antenna-panel WTRU would have explicitly or implicitly indicated one or more antenna panels to use, or “*turn on,*” in the WTRU for generating the antenna beam, thereby rendering obvious claim element [9.2].

98. For example, Xi’s TCI indicator within the DCI may also indicate the beam used for the PDSCH.

NR (New Radio/5G) may utilize dynamic beam indication for PDSCH that may need an N-bit indicator state or TCI state field in the DL-related DCI field for PDSCH beam indication.

Xi, [0083]; Xi-Provisional, [0078].

A DL beam indication for NR-PDSCH may be included in an N-bit TCI field in a DCI that utilizes a spatial QCL reference to a DL RS...

Xi, [0086]; Xi-Provisional, [0081].

99. As further explained in the analysis of claim element [1.4], a POSITA would have understood that a WTRU having multiple antenna panels, such as in Xi, provides many degrees of freedom for beamforming, such as different beam directions and beamforming gains, thereby providing improved coverage, throughput, and reliability, as compared to a WTRU that has/uses only one antenna panel.

100. For example, Xi's N-bit TCI field may indicate one of 2^N configured antenna beams, each of which corresponds to one or more antenna panels that are turned on to generate the beam (the unused panels are off). The value (*particular value*) of the TCI field (*multiple-bit IE*) implicitly indicates which antenna panels are turned on and off to generate one of the configured beams, which corresponds to "turn[ing] on a particular number of the plurality of antenna panels," thereby rendering obvious claim element [9.2].

5. Claim 10

The wireless communication device of claim 1, [10.1] wherein the indicator for antenna panel status information is contained in a Transmission Configuration Indicator (TCI) state Identity (ID) indicated by the BS.

101. Xi renders discloses or obvious claim element [10.1]. For example, see the analysis of claim elements [1.4] and [9.2].

102. For example, as explained in the analysis of [1.4], Xi teaches that its beam indicator is an implicit indication of which antenna panels to turn on because its beams are associated with specific panels, providing an example of “*an indicator for antenna panel status information*,” as the claim term is properly understood (“any implicit or explicit indication of how many, or which, antenna panels are turned on or off”)

103. Further, Xi discloses that a TCI state (within the DCI) may be used to indicate an antenna beam to the WTRU:

NR (New Radio/5G) may utilize dynamic beam indication for PDSCH that may need an **N-bit indicator state or TCI state field** in the DL-related DCI field for PDSCH beam indication.

Xi, [0083]; Xi-Provisional, [0078].

For physical downlink shared channel (PDSCH) or physical downlink control channel (PDCCH) beam indication, a radio resource control (RRC) message or signal may configure a set of M candidate **transmission configuration indication (TCI) states**.

Xi [0082]; Xi-Provisional, [0077].

A **DL beam indication for NR-PDSCH may be included in an N-bit TCI field in a DCI** that utilizes a spatial QCL reference to a DL RS... Xi, [0086]; Xi-Provisional, [0081].

104. Thus, a particular value of Xi's N-bit TCI state, received from a base station, provides a beam indication for receiving a PDSCH at a multi-antenna-panel WTRU, thereby rendering obvious "*wherein the indicator for antenna panel status information is contained in a Transmission Configuration Indicator (TCI) state Identity (ID) indicated by the BS.*"

6. Claim 11

The wireless communication device of claim 1, [11.1] wherein the plurality of leading time values is one of cell-specific values and cell group-specific values.⁴

105. In Xi, different cells may use different subcarrier spacings:

The WTRUs 102 *a*, 102 *b*, 102 *c* may communicate with gNBs 180 *a*, 180 *b*, 180*c* using communications associated with a scalable

⁴ The only relevant portion of the specification makes clear that "one of cell specific and cell-group specific values" means that only one of a "cell specific" or a "cell-group specific" value is required. '972 patent, 12:24-28 ("In some implementations of the present disclosure, the UE may maintain multiple leading time values configured by the BS or predefined in the 3GPP technical specification. **These leading time values may be cell-specific values or cell group-specific values.**").

numerology. For example, the OFDM symbol spacing and/or **OFDM subcarrier spacing (SCS) may vary for** different communications, **different cells**, and/or different portions of the wireless communication spectrum.

Xi, [0063]; Xi-Provisional, [0060]. As was well-understood and confirmed by Xi, a “cell” in the context of LTE or 5G refers to a carrier frequency:

The base station 114 a and/or the base station 114 b may be configured to transmit and/or receive wireless signals on one or more carrier frequencies, which may be referred to as a cell (not shown).

Xi, [0023]; Xi-Provisional, [0020].

106. And there may be different thresholds K (“*leading time values*”) for different subcarrier spacings (SCS):

One or more tables may be specified, pre-configured, configured, or the like to determine threshold K or Threshold-Sched-Offset. ... Table 2 and Table 3 are examples of determining or selecting threshold K.

Xi, [0097]; Xi-Provisional, [0093].

TABLE 2

Beam Indication	Units	60 kHz	120 kHz	60 kHz	120 kHz	...
		<u>SCS</u>	<u>SCS</u>	<u>SCS</u>	<u>SCS</u>	
Latency		CC1/BWP1		CC2/BWP2		
Low	Symbols	Value 1	Value 4	Value 7	Value 10	threshold K values
Latency	or Slots					
Medium	Symbols	Value 2	Value 5	Value 8	Value 11	
Latency	or Slots					
High	Symbols	Value 3	Value 6	Value 9	Value 12	
Latency	or Slots					

Xi, [0097] (annotated in color); Xi-Provisional, [0093]

107. Thus, Xi's disclosure of SCS varying for different cells, i.e., SCS is cell-specific, and different thresholds K ("leading time values") for different values of SCS, renders obvious "*the plurality of leading time values is one of cell-specific values and cell group-specific values.*"

7. Claim 12

The wireless communication device of claim 1, wherein the processor is further configured to:

[12.1] switch the antenna panel status from a first antenna panel status to a second antenna panel status in response to receiving the indicator for antenna panel status information; and

108. See analysis of [1.4] and [1.5], wherein Xi renders obvious "*receive an indicator for antenna panel status information*" and "*apply one of the plurality of leading time values to switch an antenna panel status of the plurality of antenna panels based on the indicator for antenna panel status,*" respectively. As explained in the analysis of [1.4], Xi's beam indicator (conveyed via a TCI value) is *an*

indicator for antenna panel status information because it (implicitly) indicates which panel(s) in Xi's WTRU to use. A POSITA would have generally understood that a WTRU having multiple antenna panels, such as in Xi, provides many degrees of freedom for beamforming, thereby providing increased coverage, throughput, and reliability. In other words, antenna panels, each consisting of multiple antenna elements, can generate multiple antenna beam patterns per panel for beamforming.

109. Thus, a command to switch antenna beams in Xi's multi-panel WTRU ("*indicator for antenna panel status*") renders obvious [12.1] because different antenna beams may be provided by different antenna panels.

[12.2] *automatically switch the antenna panel status from the second antenna panel status to a third antenna panel status without further reception of an indicator for antenna panel status information from the BS.*

110. As discussed in the analysis of claim 2, after receiving a beam indication (to switch to "*second antenna panel status*"), the beam may be used for a given period of time indicated by a timer. As discussed in the analysis of claim element [2.2], after the timer expires, a new beam ("*third antenna panel status*") would be used ("*automatically*"), which renders obvious [12.2].

111. For example, Xi recites:

When the timer expires, spatial QCL assumptions may become invalid.
A new spatial QCL assumption may also be **a condition** indicated or

configured that may directly overwrite the old spatial QCL assumption.

Xi, [0112]; Xi-Provisional, [0116]. And Xi discloses that the “spatial QCL assumption” is equivalent to indicating a beam. Xi, [0109] (“NR-PDSCH may use the **beam or spatial QCL assumption** indicated by the N-bit TCI in the assignment DCI.”); Xi-Provisional, [0111]. Thus, a new beam may be “a condition ...configured.” For example, the new beam “may be pre-configured and known to the WTRU in advance.” Xi, [0110]; Xi-Provisional, [0112]. When a new beam, which is pre-configured, is used, it would have been obvious that switching to a new antenna panel status (“*third antenna panel status*”) is automatic.

112. Thus, Xi discloses or renders obvious claim element [12.2].

8. Claim 14

The wireless communication device of claim 1, wherein the processor is further configured to:

[14.1] enable a power saving mode based on whether the wireless communication device operates in a particular Bandwidth Part (BWP),

113. Xi teaches that a WTRU may be configured to use various BWPs. For example, Xi’s WTRU has a “scalable numerology,” referring to specific values of communication parameters, such as subcarrier spacing, cells (which are different carriers), and different portions of the wireless spectrum, such as bandwidth part (BWP), Xi, [0063], [0098]-[0099]; Xi-Provisional, [0060], [0093]. For example, Xi’s WTRU may use one of two BWPs: BWP1 or BWP2, as illustrated in Tables 2

(reproduced below) and 3. Xi, [0097], [0099]; Xi-Provisional, [0093].

TABLE 2

Beam Indication Latency	Units	60 kHz	120 kHz	60 kHz	120 kHz
		SCS	SCS	SCS	SCS
		CC1/BWP1		CC2/BWP2	
Low	Symbols	Value 1	Value 4	Value 7	Value 10
Latency	or Slots				
Medium	Symbols	Value 2	Value 5	Value 8	Value 11
Latency	or Slots				
High	Symbols	Value 3	Value 6	Value 9	Value 12
Latency	or Slots				

Xi, [0097] (annotated in color); Xi-Provisional, [0093]

114. Furthermore, it was well-known to a POSITA that the radio frequency (RF) power consumption in a mobile device, such as Xi's WTRU, is related to the operating bandwidth, as reflected by the width of a BWP. The analog RF and digital receiver front ends, which are controlled by a processor, consume less power for smaller bandwidths. Larger operating bandwidths (e.g., BWPs with larger widths) can be used to facilitate higher data rates when needed (at the expense of higher power consumption), and, likewise, smaller operating bandwidths (e.g., BWPs with smaller widths) can be used when a lower data rate is sufficient (with the benefit of lower power consumption), as confirmed by the prior art. For example:

The power consumption of radio frequency (RF) converters, analog to digital (A/D) converters, and digital to analog (D/A)

converters, as well as the power consumption of the digital front end, can scale with the RF bandwidth. As the RF bandwidth increases, the power consumption can increase. In addition, the baseband power consumption can scale with the bit rate. As the bit rate increases, the baseband power consumption can increase.

U.S. Patent Pub. No. 2019/0373667 (Ex.1014), [0026].

When a BWP is configured for a UE, then the UE can transmit and receive data within the BWP without transmitting or receiving data outside of the configured frequency range. This can scale the operating bandwidth with the data rate which can reduce the UE power consumption at low data rates or during idling.

Ex.1014, [0029]. Thus, the power consumption of Xi's WTRU scales in accordance with the operating bandwidth of the BWP.

115. Xi teaches that its WTRU operates in different modes to provide energy savings. For example, Xi teaches switching to a "baseline mode" for "saving energy," which is an example method to "enable a power saving mode." Ex.1005, [0100] ("A WTRU may dynamically switch operation capabilities. For example, for saving energy, a WTRU may switch from advanced mode to baseline mode."); Ex.1008, [0097]. Because of the correlation between BWP and power consumption in a WTRU, it would have been obvious that when the smallest available BWP is used, Xi's WTRU uses (or "*enables*") an operating mode, such as a "baseline mode" (controlled by the "*processor*") that consumes a lower power ("*power saving mode*"), thereby disclosing or rendering obvious "*enable a power*

saving mode based on whether the wireless communication device operates in a particular Bandwidth Part (BWP),” as claimed.

Wherein:

[14.2] a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is enabled is less than a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is disabled; and

116. As explained above, Xi teaches that a WTRU dynamically switches operation capabilities, e.g., for saving energy:

A WTRU may dynamically switch operation capabilities. For example, **for saving energy, a WTRU may switch from advanced mode to baseline mode.** A WTRU may initiate or be configured by a network device, gNB, TRP, or the like to work from above 6 GHz to below 6 GHz with SCS switching available from 60/120 kHz to 15/30 kHz.

Xi, [0100]; Xi-Provisional, [0097].

117. A WTRU operation “capability” was understood as including a variety of operation aspects, including number of panels used at a given time:

WTRU capabilities may include WTRU processing time for DCI reception and decoding, WTRU processing time for beam switching, WTRU RF chain tuning time, **number of panels equipped and used simultaneously/non-simultaneously**, fixed Rx beam configurations, or the like.

Xi, [0090]; Xi-Provisional, [0084].

TABLE 2

Beam Indication Latency	Units	60 kHz	120 kHz	60 kHz	120 kHz
		SCS	SCS	SCS	SCS
		CC1/BWP1		CC2/BWP2	
Low	Symbols	Value 1	Value 4	Value 7	Value 10
Latency	or Slots				
Medium	Symbols	Value 2	Value 5	Value 8	Value 11
Latency	or Slots				
High	Symbols	Value 3	Value 6	Value 9	Value 12
Latency	or Slots				

Xi, [0097]; Xi-Provisional, [0093].

118. As discussed in the analysis of claim element [14.1], it would have been understood or obvious to a POSITA that Xi’s teaching that “[a] WTRU may dynamically switch operation capabilities,” e.g., “for saving energy,” includes a WTRU dynamically switching its number of panels to save energy (in a “*power saving mode*”). See, e.g., Ex.1007, [3] (“[F]or power saving purpose it would be preferable to switch off panels that are not needed e.g. for data transmission and/or reception.”). A POSITA would have understood that some available antenna panels would have been turned off for the “*power saving mode*” (which is also when the smallest BWP is being used, per the analysis of [14.1]) because the goal is to save energy, thereby rendering obvious “*a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is enabled is less than a total number of turned-on antenna panels in the plurality of antenna*

panels when the power saving mode is disabled,” as claimed.

[14.3] *the particular BWP is one of a default BWP, an initial BWP, and a first active BWP.*

119. Xi discloses that that “the DL active BWP for a WTRU changes dynamically,” and “the UL active BWP for a WTRU changes dynamically,” Xi, [0205]; Xi-Provisional, [0207]-[0208], which discloses or renders obvious that the first-used “active BWP” in Xi is an example of “*a first active BWP*” as claimed.

120. Additionally, the ’972 Patent defines the expression “at least one of A, B and C” as follows: “The expression ‘at least one of A, B and C’ or ‘at least one of the following: A, B and C’ means ‘only A, or only B, or only C, or any combination of A, B and C.’” ’972 Patent, 3:62-65. Thus, only one of “*a default BWP*,” “*an initial BWP*,” or “*a first active BWP*” needs to be disclosed to satisfy the claim element.

9. Claim 15

[15.0] *A method performed by a wireless communication device for operating a plurality of antenna panels, the method comprising:*

121. As explained in the analysis of claim element [1.0], Xi discloses a wireless transmit/receive unit (WTRU), which is an example “*wireless communication device*,” as claimed. And as explained in the analysis of claim element [1.1], Xi’s WTRU may include multiple antenna panels, which is an example of “*a plurality of antenna panels*,” as claimed. Various actions/steps

discussed below are disclosed as being performed by Xi's WTRU, therefore disclosing a "*method*" performed by a wireless communication device. Thus, Xi discloses claim element [15.0].

[15.1] *maintaining a plurality of leading time values, the plurality of leading time values indicating a plurality of leading time durations;*

122. Claim element [15.1] is substantively the same as claim element [1.3].

Therefore, Xi discloses or renders obvious claim element [15.1] for the reasons given in the analysis of [1.3].

[15.2] *receiving an indicator for antenna panel status information from a base station (BS);*

123. Claim element [15.2] is substantively the same as claim element [1.4].

Therefore, Xi discloses or renders obvious claim element [15.2] for the reasons given in the analysis of [1.4].

[15.3] *applying one of the plurality of leading time values to switch an antenna panel status of the plurality of antenna panels based on the indicator for antenna panel status information;*

124. Claim element [15.3] is substantively the same as claim element [1.5].

Therefore, Xi discloses or renders obvious claim element [15.3] for the reasons given in the analysis of [1.5].

[15.4] *receiving a scheduling offset value from the BS, the scheduling offset value comprising at least one of a K0 parameter for a Downlink (DL) channel and a K2 parameter for an Uplink (UL) channel; and*

125. Claim element [15.4] is substantively the same as claim element [1.6].

Therefore, Xi discloses or renders obvious claim element [15.4] for the reasons given in the analysis of [1.6].

[15.5] *determining that the scheduling offset value is invalid, when a time duration indicated by the scheduling offset value is less than a leading time duration indicated by the applied leading time value.*

126. Claim element [15.5] is substantively the same as claim element [1.7].

Therefore, Xi discloses or renders obvious claim element [15.5] for the reasons given in the analysis of [1.7].

10. Claim 16

***The method of claim 15, further comprising:
[16.1] receiving a timer from the BS; and***

127. Claim element [16.1] is substantively the same as claim element [2.1].

Therefore, Xi discloses or renders obvious claim element [16.1] for the reasons given in the analysis of [2.1].

[16.2] *switching the antenna panel status from a first antenna panel status to a second antenna panel status after the timer expires.*

128. Claim element [16.2] is substantively the same as claim element [2.2].

Therefore, Xi discloses or renders obvious claim element [16.2] for the reasons given in the analysis of [2.2].

11. Claim 23

The method of claim 15, [23.1] wherein the indicator for antenna panel status information comprises a multiple-bit Information Element (IE), and the method further comprises:

129. Claim element [23.1] is substantively the same as claim element [9.1].

Therefore, Xi discloses or renders obvious claim element [23.1] for the reasons given in the analysis of [9.1].

[23.2] *turning on a particular number of the plurality of antenna panels when the multiple-bit IE is set to a particular value.*

130. Claim element [23.2] is substantively the same as claim element [9.2].

Therefore, Xi discloses or renders obvious claim element [23.2] for the reasons given in the analysis of [9.2].

12. Claim 24

***The method of claim 15,
[24.1] wherein the indicator for antenna panel status information is contained in a Transmission Configuration Indicator (TCI) state Identity (ID) indicated by the BS.***

131. Claim element [24.1] is substantively the same as claim element [10.1]. Therefore, Xi discloses or renders obvious claim element [24.1] for the reasons given in the analysis of [10.1].

13. Claim 25

***The method of claim 15,
[25.1] wherein the plurality of leading time values is one of cell-specific values and cell group-specific values.***

132. Claim element [25.1] is substantively the same as claim element [11.1]. Therefore, Xi discloses or renders obvious claim element [25.1] for the reasons given in the analysis of [11.1].

14. Claim 26

The method of claim 15, further comprising:

[26.1] switching the antenna panel status from a first antenna panel status to a second antenna panel status in response to receiving the indicator for antenna panel status information; and

133. Claim element [26.1] is substantively the same as claim element [12.1]. Therefore, Xi discloses or renders obvious claim element [26.1] for the reasons given in the analysis of [12.1].

[26.2] automatically switch the antenna panel status from the second antenna panel status to a third antenna panel status without further reception of an indicator for antenna panel status information from the BS.

134. Claim element [26.2] is substantively the same as claim element [12.2]. Therefore, Xi discloses or renders obvious claim element [26.2] for the reasons given in the analysis of [12.2].

15. Claim 28

The method of claim 15, further comprising:

[28.1] enabling a power saving mode based on whether the wireless communication device operates in a particular Bandwidth Part (BWP),

135. Claim element [28.1] is substantively the same as claim element [14.1]. Therefore, Xi discloses or renders obvious claim element [28.1] for the reasons given in the analysis of [14.1].

wherein: [28.2] a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is enabled is less than a total number of turned-on antenna panels when the power saving mode is disabled; and

136. Claim element [28.2] is substantively the same as claim element [14.2]. Therefore, Xi discloses or renders obvious claim element [28.2] for the reasons given in the analysis of [14.2].

[28.3] *the particular BWP is one of a default BWP, an initial BWP, and a first active BWP.*

137. Claim element [28.3] is substantively the same as claim element [14.3]. Therefore, Xi discloses or renders obvious claim element [28.3] for the reasons given in the analysis of [14.3].

B. Ground 2: Claims 8, 13, 14, 22, 27, and 28 are obvious under 35 U.S.C. § 103 over Xi combined with Deenoo.

1. Summary of Deenoo

138. Because conflicts may arise between power management and beam management if they are managed separately, Deenoo recognizes that it can be beneficial to coordinate power management and beam management in a WTRU. “The term Discontinuous Reception (DRX) may refer to any form of power saving applied by a WTRU, which may be characterized by reduced reception and/or transmission activity.” Deenoo, [0093]. Deenoo recognizes that “[a] potential conflict may arise if DRX management and beam management are optimized separately.” Deenoo, [0006]; *see also* [0101] (“Under certain conditions, beam management and power savings may be in conflict with each other.”).

139. As a solution to these issues, “procedures for joint beam management

and power savings are proposed such that the two may be optimized under various conditions.” Deenoo, [0101]. Deenoo further describes coordinated control of power management and beam management, via a linking/mapping between power savings states and beam management states:

According to one or more embodiments, a set of power savings states (e.g., different levels of layer 1 (L1) and layer 2 (L2) processing and/or RF configuration) may be linked or mapped with beam management states (e.g., different levels of beam management), such that a transition between two states at the power savings procedure may induce similar transition at the beam management level, and vice-versa.

Deenoo, [0147]. “The linkage between power states (e.g., DRX states) and BM states may be beneficial to reduce signaling overhead between the WTRU and the network.” Deenoo, [0183].

2. Reasons to Combine Xi and Deenoo

140. Xi and Deenoo are analogous art to the '972 patent, as all three documents are directed to the field of cellular communications, such as LTE and 5G/NR systems. '972 patent, 1:15-16 (“The present disclosure generally relates to wireless communications...”); 4:38-43 (“A radio communication network architecture (e.g., a long term evolution (LTE) system, an LTE-Advanced (LTE-A) system, an LTE-Advanced Pro system, or a 5G New Radio (NR) Radio Access Network) typically includes at least one BS, at least one UE, and one or more optional network elements that provide connection towards a network.”); Xi,

[0026]-[0027] (“In an embodiment, the base station 114 a and the WTRUs 102a, 102b, 102c may implement a radio technology such as Evolved UMTS Terrestrial Radio Access (E-UTRA), which may establish the air interface 116 using Long Term Evolution (LTE) and/or LTE-Advanced (LTE-A) and/or LTE-Advanced Pro (LTE-A Pro); Xi-Provisional, [0023]-[0024]. In an embodiment, the base station 114 a and the WTRUs 102a, 102b, 102c may implement a radio technology such as NR Radio Access, which may establish the air interface 116 using New Radio (NR).”); Deenoo, [0031]-[0032] (“In an embodiment, the base station 114 a and the WTRUs 102a, 102b, 102c may implement a radio technology such as Evolved UMTS Terrestrial Radio Access (E-UTRA), which may establish the air interface 116 using Long Term Evolution (LTE) and/or LTE-Advanced (LTE-A) and/or LTE-Advanced Pro (LTE-A Pro). In an embodiment, the base station 114a and the WTRUs 102a, 102b, 102c may implement a radio technology such as NR Radio Access, which may establish the air interface 116 using NR.”).

141. It is my opinion that it would have been obvious to a POSITA to combine Xi and Deenoo to provide the obvious, predictable, and beneficial result of coupling Deenoo’s power management states with Xi’s beam management states to beneficially avoid conflicts between beam management states and power management states, and reduce signaling overhead that would otherwise be required to manage the two types of states separately, according to the benefits

presented in Deenoo. *See* Deenoo, [0101] (avoid conflict), [0183] (“The linkage between power states (e.g., DRX states) and BM states may be **beneficial to reduce signaling overhead** between the WTRU and the network.”).

142. As further described herein, Xi is directed to “beam management (BM) for new radio,” which may include “beam pairing,” Xi, [0080], and selection and indication of antenna beams to a WTRU, *see, e.g.*, Xi, [0081] (“BM may include DL layer 1 (L1)/layer 2 (L2) BM procedures for selection of TRP Tx/WTRU Rx beams within one or more TRPs.”); Xi-Provisional, [0076]. Deenoo is likewise directed to beam management, and Deenoo uses the term “beam management” or “BM” in the same way as Xi, such as referring to properties or characteristics of an antenna beam. Deenoo, [0156] (“The BM states 21-24 may differ in which types of beams (e.g., wide and/or narrow) are paired between the WTRU and the network, the number of beams paired, the characteristics of the beams themselves, and/or any other parameter associated with beam management procedure.”); [0113]-[0118].

143. Deenoo is additionally directed to power management, which can be jointly performed with beam management (BM) in a WTRU. In particular, Deenoo describes “systems, apparatuses, and methods for method for jointly performing beam management and power management in a wireless system,” Deenoo, [0007], such as “in a wireless transmit/receive unit (WTRU).” Deenoo, [0008]. In Deenoo,

power management states and beam management states can be “linked” or “associated,” such as through an “implicit relationship.” Deenoo, [0174] (“As noted above, each of the power states 11-14 is linked to or associated with a different one of the BM states 21-24, for example, via an implicit relationship.”).

144. As described previously (e.g., in the analysis of claim element [1.4]), Xi describes the use of an N-bit indicator state or TCI state field in DCI for indicating the beam used for a subsequent PDSCH. *See, e.g.,* Xi, [0083] (“NR (New Radio/5G) may utilize dynamic beam indication for PDSCH that may need an N-bit indicator state or TCI state field in the DL-related DCI field for PDSCH beam indication.”); Xi-Provisional, [0078]. Consistent with Xi’s teachings, Deenoo recognizes that a “WTRU may be configured by the network to enter a BM state.” Deenoo, [0200]. When combined with Deenoo’s teachings, Xi’s beam indicator can also indicate a power management state, via an implicit relationship. Deenoo, [0183] (“[A] change in BM state at the WTRU may result in a change of the power saving state of the WTRU based on the configured linkage between BM states and power saving states.”).

145. Linking beam management states (such as those presented in Xi) and power management states provides some known benefits to a POSITA, as recognized by Deenoo. For example, conflicts between beam management states and power management states can be avoided:

Under certain conditions, beam management and power savings may be in conflict with each other. Thus, procedures for joint beam management and power savings are proposed such that the two may be optimized under various conditions (e.g., network capabilities, WTRU capabilities, and communication environments, such as channel quality, available bandwidth, single beam transmission, multi-beam transmission, etc.) and use cases, and may further be adapted on a dynamic basis as conditions and use cases change.

Deenoo, [0101]. Linking beam management (BM) states (such as those presented in Xi) with power management states also beneficially reduces signaling overhead, per Deenoo:

The linkage between power states (e.g., DRX states) and BM states may be beneficial to reduce signaling overhead between the WTRU and the network.”).

Deenoo, [0183].

146. Xi combined with Deenoo also represents combining prior art elements (pairing beam states/indications of Xi with power management states of Deenoo, according to Deenoo’s explicit teachings) according to known methods to yield the predictable and beneficial result of having each beam indication linked to or associated with a different one of power management states to avoid conflicts between the different types of states and reduce signaling overhead.

3. Claim 8

The wireless communication device of claim 1,

[8.1] wherein the indicator for antenna panel status information comprises a single-bit Information Element (IE), and the processor is further configured to:

147. Xi discloses or renders obvious claim element [8.1].

148. As explained in the analysis of [1.4], Xi discloses a TCI state field that provides a beam indication (example “*indicator for antenna panel status information*”) that is represented by N bits. For example, Xi recites:

NR (New Radio/5G) may utilize dynamic beam indication for PDSCH that may need an N-bit indicator state or TCI state field in the DL-related DCI field for PDSCH beam indication.

Xi, [0083]; Xi-Provisional, [0078].

149. The range of values of N encompasses one bit (reflecting two possible values for the TCI state), thereby disclosing or rendering obvious “*the indicator for antenna panel status information comprises a single-bit Information Element (IE).*”

[8.2] enable a power saving mode when the single-bit IE is set to a first value; and disable the power saving mode when the single-bit IE is set to a second value, wherein a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is enabled is less than a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is disabled.

150. Xi renders obvious claim element [8.2]. Xi combined with Deenoo also renders obvious [8.2].

151. It would have been obvious to a POSITA that if Xi commands a WTRU to switch, using a single-bit TCI indicator, between a beam with a high

beamforming gain, *see, e.g.*, Xi, [0080] (“a large-scale antenna array may be used to achieve high beamforming gain to compensate for the high propagation loss”), Xi-Provisional, [0076], and a beam with low beamforming gain, a different number of antenna elements (e.g., using a different number of antenna panels) may be used to generate the different beamforming gains. For example, Deenoo explains what POSITAs understood:

Beamforming may be also desired to compensate for increased pathloss at higher frequencies (e.g. >6 GHz). **A large number of antenna elements may be used to achieve higher beamforming gain.**

Deenoo, [0091]. A POSITA would have understood that a higher beamforming gain is achieved at the expense of increased power consumption (e.g., due to increased hardware sufficient for supporting an increased number of antenna elements). For example, Deenoo explains that a high beamforming gain may no longer be needed when a WTRU enters a sleep cycle (“DRX cycle”), which is a low-power cycle. Deenoo, [0176] (“A WTRU may exit a beam management state (e.g., BM state 24) associated with candidate beams and/or high gain narrow beams upon entering a long DRX cycle.”).

152. Further, Xi teaches that its WTRU operates in different modes to provide energy savings. For example, Xi teaches switching to a “baseline mode” for “saving energy,” which is an example of “*enable a power saving mode.*” Xi, [0100] (“A WTRU may dynamically switch operation capabilities. For example,

for saving energy, a WTRU may switch from advanced mode to baseline mode.”); Xi-Provisional, [0097]. It would have been obvious for the WTRU to enter a “baseline mode” for “saving energy,” such as switching off RF circuitry, when a beam with a high beamforming gain is indicated using the TCI and a smaller number of antenna panels is used, as compared to a state of using a larger number of antenna panels when a beam with a low beamforming gain is indicated, thereby rendering obvious [8.2].

153. Xi combined with Deenoo also renders obvious [8.2].

154. Deenoo describes coordinated control of power management and beam management, via a linking between power savings states and beam management states:

According to one or more embodiments, a set of power savings states (e.g., different levels of layer 1 (L1) and layer 2 (L2) processing and/or RF configuration) may be linked or mapped with beam management states (e.g., different levels of beam management), such that a transition between two states at the power savings procedure may induce similar transition at the beam management level, and vice-versa.

Deenoo, [0147].

As noted above, each of the power states 11-14 is linked to or associated with a different one of the BM states 21-24, for example, via an implicit relationship. This linking information may be provided in configuration information or control information provided by the network. Alternatively, the WTRU may be preconfigured with the linked

information that maps the power states and BM states to each other. Thus, a WTRU may be configured with a set of power states 11-14 having different levels of L1/L2 processing and/or RF configurations coupled with a set of beam management states 21-24 having different levels of beam measurement, feedback reporting and/or UL beam reference signal transmissions.

Deenoo, [0174].

155. A BM (beam management) state may refer to a “parameter configuration” for a “beam management procedure”:

A WTRU may be configured with a plurality of beam management (BM) states. ...In another example, different BM states may be associated with a same beam management procedure but **a different parameter configuration for the beam management procedure.**

Deenoo, [0131].

156. There are a variety of parameters for Deenoo’s beam management procedures, including properties or characteristics of a beam:

A BMP [beam management procedure] may be characterized by one or more of the following BMP parameters. One BMP parameter may be the number of beams involved in the BMP (e.g., all beams, a subset of beams, or one beam).

...

Another BMP parameter may be one or more properties of the beam

...

Deenoo, [0113]-[0118].

The BM states 21-24 may differ in which types of beams (e.g., wide and/or narrow) are paired between the WTRU and the network, the number of beams paired, the characteristics of the beams themselves, and/or any other parameter associated with beam management procedure.

Deenoo, [0156].

157. Thus, Xi's one-bit TCI indicator that indicates a selected beam (*"single bit IE is set to a first value"* or *"a second value"*), in view of Deenoo's teaching that there is an implicit linking between a beam management (BM) state and a power state, such that one beam selection (*"first value"*) is implicitly associated with a power state (e.g., *"power savings mode"*) and another beam selection (*"second value"*) is implicitly associated with another power state, renders obvious [8.2]. When the TCI value is set to a first value, the number of turned on antenna panels is less than when the TCI value is set to a second value (*"wherein a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is enabled is less than a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is disabled"*).

4. Claim 13

The wireless communication device of claim 1, wherein the processor is further configured to:

[13.1] enable a power saving mode when the wireless communication device operates in a Discontinuous Reception (DRX) active time; and disable the power

saving mode when the wireless communication device operates in a DRX inactive time,

158. Xi in view of Deenoo discloses or renders obvious claim element [13.1]. As discussed in association with claim 14, Xi teaches that a WTRU dynamically switches operation modes for “saving energy.” Xi, [0100] (“A WTRU may dynamically switch operation capabilities. For example, for saving energy, a WTRU may switch from advanced mode to baseline mode.”); Xi-Provisional, [0097].

159. Deenoo discloses sending a DRX command to a WTRU to transition from a non-DRX state to a DRX state:

Another trigger associated with a DRX state may **be receipt of a DRX command from the network (e.g., a base station)**. The WTRU may implicitly transition to a predefined BM state based on reception of a DRX command from the network.... That is, **the network may order a WTRU in a non-DRX state to enter DRX by transmitting an explicit DRX command**.

Deenoo, [0189]. Thus, the DRX command may command a WTRU to enter a DRX state (“*DRX active time*”) from a non-DRX state (“*DRX inactive time*”), for example.

160. The transition to a BM state may also trigger an transition to a power state, due to the linkage between BM states and power states as described in the analysis of claim element [8.2]. For example, Deenoo recites:

According to one or more embodiments, a set of power savings states (e.g., different levels of layer 1 (L1) and layer 2 (L2) processing and/or RF configuration) may be linked or mapped with beam management states (e.g., different levels of beam management), such that **a transition between two states at the power savings procedure may induce similar transition at the beam management level, and vice-versa.**

Deenoo, [0147].

161. Similarly, Deenoo further describes a linking between power states and beam management (BM) states:

As noted above, each of the power states 11-14 is linked to or associated with a different one of the BM states 21-24, for example, via an implicit relationship.

Deenoo, [0174].

162. Thus, Xi's teaching of a power saving mode in view of Deenoo's description of receiving a DRX command, which can trigger a transition to a BM state and an associated power state, discloses or renders obvious "*enable a power saving mode when the wireless communication device operates in a Discontinuous Reception (DRX) active time.*"

[13.2] wherein a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is enabled is less than a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is disabled.

163. Deenoo's DRX command triggers an associated change in power

state, and a power state may reflect the RF configuration (Deenoo, [0174] (“a WTRU may be configured with **a set of power states 11-14 having different levels of L1/L2 processing and/or RF configuration**”)). Further, the RF configuration was understood as reflecting the number of antenna panels, according to Xi. *See* Xi, [0090] (“WTRU capabilities may include ... number of panels equipped and used simultaneously/non-simultaneously”); Xi-Provisional, [0084].

164. It was well-known to a POSITA that higher beamforming gain in a WTRU is achieved at the expense of increased WTRU power consumption (e.g., via the use of increased hardware capability to support an increased number of antenna elements). Consistent with this principle, Deenoo recognizes that when a sleep mode is used in a WTRU (e.g., a long DRX cycle), it is desirable to exit a beam management mode that uses high beamforming gain:

A WTRU may exit a beam management state (e.g., BM state 24) associated with candidate beams and/or high gain narrow beams upon entering a long DRX cycle.

Deenoo, [0176]; *see also* [0180]. A “DRX cycle” refers to a duty cycle in which a WTRU “wakes up” every so often to monitor a control channel (the PDCCH). Deenoo, [0096]-[0097]. Thus, it would have been understood or obvious to a POSITA that fewer antenna panels are needed to be activated when a WTRU simply wakes up to monitor a control channel (e.g., one antenna panel may

suffice), as compared to when a data transmission is being received (e.g., on a data channel, such as PDSCH). *See also* Deenoo, [0187] (“For example, a WTRU in the first BM state (e.g., BM state A) during the start of the on-duration may transition to the second BM state (e.g., BM state B) upon receiving a valid scheduling grant while monitoring the PDCCH.”). Such WTRU operation of reducing the number of panels that are turned on is consistent with an objective of power or DRX management, which is to save power when there is no data activity. Deenoo, [0005] (“Thus, a focus of DRX management may be to enable power savings when there is no data activity at the UE.”); Ex.1007, [3] (“[F]or power saving purpose it would be preferable to switch off panels that are not needed e.g. for data transmission and/or reception.”).

165. Accordingly, it would have been obvious to a POSITA that the number of panels in Xi’s WTRU used in a low power state associated with waking up every so often to monitor a control channel would have been less than the number of panels in a power state associated with data transmission, thereby rendering obvious claim element [13.2].

5. Claim 22

The method of claim 15, [22.1] wherein the indicator for antenna panel status information comprises a single-bit Information Element (IE), and the method further comprises:

166. Claim element [22.1] is substantively the same as claim element [8.1].

Therefore, Xi discloses or renders obvious claim element [22.1] for the reasons given in the analysis of [8.1].

[22.2] *enabling a power saving mode when the single-bit IE is set to a first value; and disabling the power saving mode when the single-bit IE is set to a second value, wherein a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is enabled is less than a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is disabled.*

167. Claim element [22.2] is substantively the same as claim element [8.2].

Therefore, Xi discloses or renders obvious claim element [22.2], as does Xi combined with Deenoo, for the reasons given in the analysis of [8.2].

6. Claim 27

The method of claim 15, further comprising:

[27.1] *enabling a power saving mode when the wireless communication device operates in a Discontinuous Reception (DRX) active time; and disabling the power saving mode when the wireless communication device operates in a DRX inactive time,*

168. Claim element [27.1] is substantively the same as claim element [13.1]. Therefore, Deenoo discloses or renders obvious claim element [27.1] for the reasons given in the analysis of [13.1].

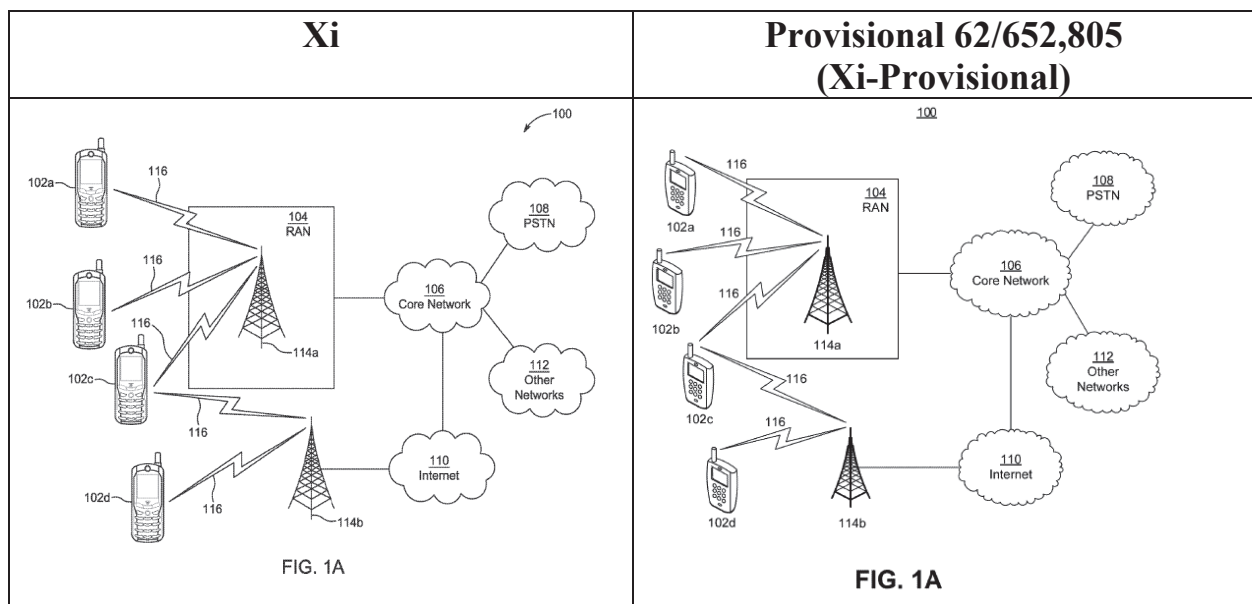
[27.2] *wherein a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is enabled is less than a total number of turned-on antenna panels in the plurality of antenna panels when the power saving mode is disabled.*

169. Claim element [27.2] is substantively the same as claim element [13.2]. Therefore, Xi combined with Deenoo discloses or renders obvious claim

element [27.2] for the reasons given in the analysis of [13.2].

IX. COMPARISON CHART OF XI VERSUS XI-PROVISIONAL

170. Below I provide a comparison chart. The chart compares the disclosures relied upon in the Petition and in my declaration from Xi (Ex.1005) in the left column and the corresponding disclosures of U.S. Provisional App. No. 62/652,805 (“Xi-Provisional,” Ex.1008) in the right column. In general, I have included figures only once, so as to avoid unnecessary repetition. As the chart shows, there are no substantive differences between Xi and the corresponding disclosures of Xi-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.



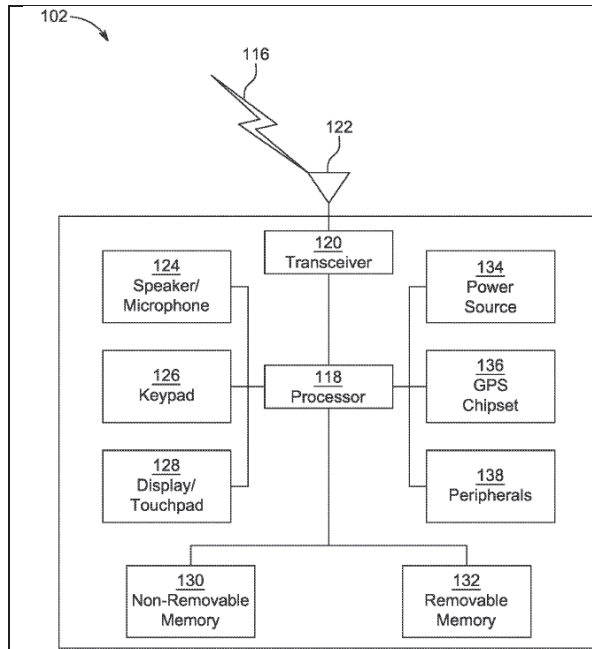


FIG. 1B

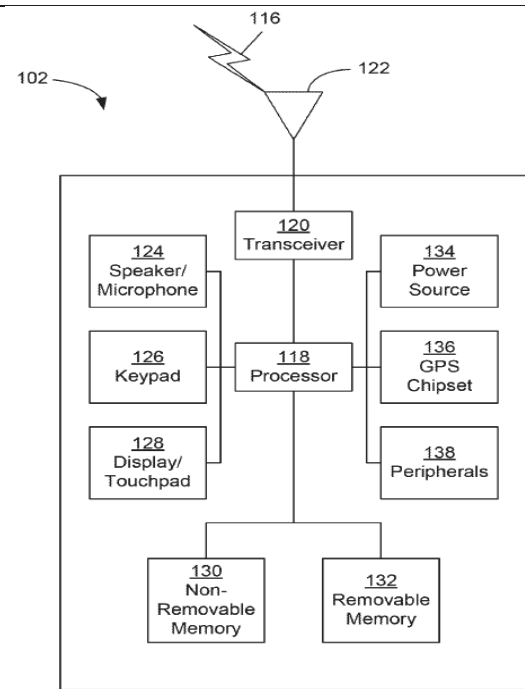


FIG. 1B

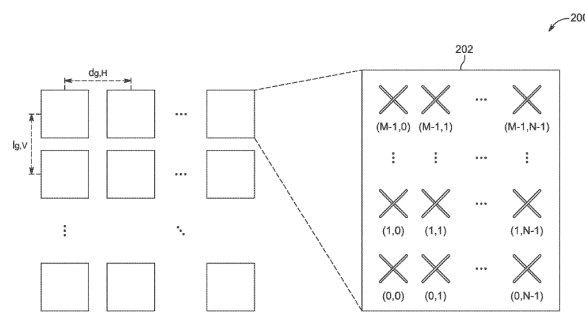


FIG. 2

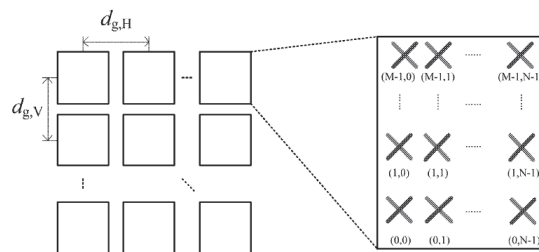


FIG. 2

As shown in FIG. 1A, the communications system 100 may include wireless transmit/receive units (WTRUs) 102a, 102b, 102c, 102d ... Each of the WTRUs 102 a, 102 b, 102 c, 102 d may be any type of device configured to operate and/or communicate in a wireless environment.
Xi, [0021].

The base station 114 a and/or the base station 114 b may be configured to

As shown in FIG. 1A, the communications system 100 may include wireless transmit/receive units (WTRUs) 102a, 102b, 102c, 102d... Each of the WTRUs 102a, 102b, 102c, 102d may be any type of device configured to operate and/or communicate in a wireless environment.
Xi-Provisional, [0034].

The base station 114a and/or the base station 114b may be configured to

transmit and/or receive wireless signals on one or more carrier frequencies, which may be referred to as a cell (not shown). Xi, [0023].	transmit and/or receive wireless signals on one or more carrier frequencies, which may be referred to as a cell (not shown). Xi-Provisional, [0020].
In an embodiment, the base station 114a and the WTRUs 102a, 102b, 102c may implement a radio technology such as Evolved UMTS Terrestrial Radio Access (E-UTRA), which may establish the air interface 116 using Long Term Evolution (LTE) and/or LTE-Advanced (LTE-A) and/or LTE-Advanced Pro (LTE-A Pro).	In an embodiment, the base station 114a and the WTRUs 102a, 102b, 102c may implement a radio technology such as Evolved UMTS Terrestrial Radio Access (E-UTRA), which may establish the air interface 116 using Long Term Evolution (LTE) and/or LTE-Advanced (LTE-A) and/or LTE-Advanced Pro (LTE-A Pro).
In an embodiment, the base station 114a and the WTRUs 102a, 102b, 102c may implement a radio technology such as NR Radio Access, which may establish the air interface 116 using New Radio (NR). Xi, [0026]-[0027].	In an embodiment, the base station 114a and the WTRUs 102a, 102b, 102c may implement a radio technology such as NR Radio Access, which may establish the air interface 116 using New Radio (NR). Xi-Provisional, [0023]-[0024].
FIG. 1B is a system diagram illustrating an example WTRU 102. As shown in FIG. 1B, the WTRU 102 may include a processor 118, a transceiver 120, a transmit/receive element 122, a speaker/microphone 124, a keypad 126, a display/touchpad 128, non-removable memory 130, removable memory 132, a power source 134, a global positioning system (GPS) chipset 136, and/or other peripherals 138, among others. It will be appreciated that the WTRU 102 may include any sub-combination of the foregoing elements while remaining consistent with an embodiment. Xi, [0034].	FIG. 1B is a system diagram illustrating an example WTRU 102. As shown in FIG. 1B, the WTRU 102 may include a processor 118, a transceiver 120, a transmit/receive element 122, a speaker/microphone 124, a keypad 126, a display/touchpad 128, non-removable memory 130, removable memory 132, a power source 134, a global positioning system (GPS) chipset 136, and/or other peripherals 138, among others. It will be appreciated that the WTRU 102 may include any sub-combination of the foregoing elements while remaining consistent with an embodiment. Xi-Provisional, [0031].

The processor 118 may be coupled to the transceiver 120, which may be coupled to the transmit/receive element 122. While FIG. 1B depicts the processor 118 and the transceiver 120 as separate components, it will be appreciated that the processor 118 and the transceiver 120 may be integrated together in an electronic package or chip. Xi, [0035].	The processor 118 may be coupled to the transceiver 120, which may be coupled to the transmit/receive element 122. While FIG. 1B depicts the processor 118 and the transceiver 120 as separate components, it will be appreciated that the processor 118 and the transceiver 120 may be integrated together in an electronic package or chip. Xi-Provisional, [0032].
Although the transmit/receive element 122 is depicted in FIG. 1B as a single element, the WTRU 102 may include any number of transmit/receive elements 122. More specifically, the WTRU 102 may employ MIMO technology. Thus, in one embodiment, the WTRU 102 may include two or more transmit/receive elements 122 (e.g., multiple antennas) for transmitting and receiving wireless signals over the air interface 116. Xi, [0037].	Although the transmit/receive element 122 is depicted in FIG. 1B as a single element, the WTRU 102 may include any number of transmit/receive elements 122. More specifically, the WTRU 102 may employ MIMO technology. Thus, in one embodiment, the WTRU 102 may include two or more transmit/receive elements 122 (e.g., multiple antennas) for transmitting and receiving wireless signals over the air interface 116. Xi-Provisional, [0034].
MTC [Meter Type Control/Machine-Type Communication] devices may have certain capabilities, for example, limited capabilities including support for (e.g., only support for) certain and/or limited bandwidths. Xi, [0058].	MTC devices may have certain capabilities, for example, limited capabilities including support for (e.g., only support for) certain and/or limited bandwidths. Xi-Provisional, [0055].
The WTRUs 102a, 102b, 102c may communicate with gNBs 180a, 180b, 180c using communications associated with a scalable numerology. For example, the OFDM symbol spacing and/or OFDM subcarrier spacing (SCS) may vary for different	The WTRUs 102a, 102b, 102c may communicate with gNBs 180a, 180b, 180c using transmissions associated with a scalable numerology. For example, the OFDM symbol spacing and/or OFDM subcarrier spacing may vary for different transmissions,

communications, different cells, and/or different portions of the wireless communication spectrum. Xi, [0063].	different cells, and/or different portions of the wireless transmission spectrum. Xi-Provisional, [0060].
Multiple antennas may deliver diversity gain, multiplexing gain, beamforming, array gain, or the like. Xi, [0075].	Different MIMO techniques may deliver different benefits such as providing diversity gain, multiplexing gain, beamforming, array gain, etc. Xi-Provisional, [0072].
FIG. 2 is diagram of an example of a transmission reception point (TRP) and WTRU antenna model 200. A massive antenna model 202 may be configured as M_g antenna panels per vertical dimension and N_g antenna panels per horizontal dimension. Each antenna panel may be configured with N columns and M rows of antenna elements with or without polarization. Xi, [0077].	Multiple antenna transmission at millimeter wave frequencies differ slightly from sub-6 GHz multiple antenna techniques. This is due to the different propagation characteristics at millimeter wave frequencies and the possibility of the base stations/WTRUs having a limited number of RF chains compared with antenna elements. The massive antenna model may be configured as M_g antenna panels per vertical dimension and N_g antenna panels per horizontal dimension, wherein each antenna panel may be configured with N columns and M rows of antenna elements with or without polarization as shown in the FIG. 1. [<i>sic</i> – FIG. 2]. The timing and phase may be not be calibrated across panels although multiple panels may be equipped in the same eNB. The baseline massive antenna configuration may be different according to the operating frequency band as listed in Table 1. Xi-Provisional, [0073]-[0074].
In beam management (BM) for new radio, as frequencies increase, the	As frequencies increase, the channel may experience higher path losses and

channel may experience higher path losses and more abrupt changes. In high frequency bands, a large-scale antenna array may be used to achieve high beamforming gain to compensate for the high propagation loss. A coupling loss may be managed for a desired data throughput or coverage. Directional beam based communication may need accurate beam pairing, real channel conditions, angle of arrival and angle of departure in both azimuth and elevation, or the like. Beam direction may be dynamically adjusted with channel change. Xi, [0080].	more abrupt changes. In high frequency bands, a large-scale antenna array may be used to achieve high beamforming gain so as to compensate for the high propagation loss. The resulting coupling loss could be kept at a high level to support the desired data throughput or coverage. The use of a directional beam based communication may require an accurate beam pairing, and the correct beam direction may need to be associated with a real channel, in terms of angle of arrival and angle of departure in both azimuth and elevation. Xi-Provisional, [0076].
BM may include DL layer 1 (L1)/layer 2 (L2) BM procedures for selection of TRP Tx/WTRU Rx beams within one or more TRPs, one or more high level procedures (P-1, P-2, P-3) for beam selection, Tx beam refinement, Rx beam change, TRP Tx and WTRU Rx beam sweep, WTRU-triggered beam failure recovery for NR, beam group based reporting and WTRU-specific configured BM, or the like. Xi, [0081].	Beam Management (BM) may cover a number of topics, such as: DL L1/L2 BM procedures for selection of TRP Tx/WTRU Rx beams are supported within one or multiple TRPs; 3 high level procedures (P-1, P-2, P-3) for beam selection, Tx beam refinement, Rx beam change; procedures that may involve TRP Tx and WTRU Rx beam sweep; WTRU-triggered mechanisms to recover from beam failure in NR environments; beam group based reporting and WTRU-specific configured BM. Xi-Provisional, [0076].
... a set of M candidate transmission configuration indication (TCI) states. Xi, [0082].	... a set of M candidate Transmission Configuration Indication (TCI) States. Xi-Provisional, [0077].
NR (New Radio/5G) may utilize dynamic beam indication for PDSCH that may need an N-bit indicator state	NR may support dynamic beam indication for PDSCH. To facilitate such functionality, there may be an N-bit indicator state or TCI state field in

or TCI state field in the DL-related DCI field for PDSCH beam indication. Xi, [0083].	the DL-related DCI field for PDSCH beam indication. Xi-Provisional, [0078].
For timing of beam indication for NR-PDSCH, when spatial QCL is configured or indicated, a present TCI field may be located in the associated DCI for NR-PDSCH scheduling independent of same-slot scheduling or cross-slot scheduling. For the examples given herein, a parameter or variable K may be utilized as a threshold, a level, a numerical point, or the like. When the scheduling offset $\geq$ threshold K, then NR-PDSCH may use the beam or spatial QCL parameter indicated by the N-bit TCI field in the assignment DCI. When the scheduling offset $<$ threshold K, then NR-PDSCH may use a pre-configured, pre-defined, rule-based, or the like spatial assumption with various QCL parameters that may be obtained from the N-bit TCI state field in the DCI. In certain configurations, threshold K may be based on WTRU capability when one or more candidate values of threshold K are available. Xi, [0084].	Concerning timing issues of beam indication for NR-PDSCH, for the case when at least spatial QCL is configured/indicated, NR supports the beam indication for NR-PDSCH as follows, if TCI field is present: the TCI field may always present in the associated DCI for NR-PDSCH scheduling irrespective of same-slot scheduling or cross-slot scheduling; when the scheduling offset $\geq$ threshold K, then NR-PDSCH may use the beam (spatial QCL parameter) indicated by the N-bit TCI field in the assignment DCI; when the scheduling offset $<$ threshold K, then NR-PDSCH may use a pre-configured/pre-defined/rule-based spatial assumption, but more details may be needed. For example, embodiments discussed herein may address the other QCL parameters that may be obtained from the N-bit TCI state field in the DCI. In another example, embodiments discussed herein may address how to update pre-configured/pre-defined spatial assumption (if applicable). Threshold K may be based on WTRU capability only if multiple candidate values of K are supported. Xi-Provisional, [0079].
For timing of beam indication for NR-PDSCH, when spatial QCL is configured or indicated, a present TCI field may be located in the associated DCI for NR-PDSCH scheduling	Concerning timing issues of beam indication for NR-PDSCH, for the case when at least spatial QCL is configured/indicated, NR supports the beam indication for NR-PDSCH as

independent of same-slot scheduling or cross-slot scheduling. Xi, [0084].	follows, if TCI field is present: the TCI field may always present in the associated DCI for NR-PDSCH scheduling irrespective of same-slot scheduling or cross-slot scheduling. Xi-Provisional, [0079].
A DL beam indication for NR-PDSCH may be included in an N-bit TCI field in a DCI that utilizes a spatial QCL reference to a DL RS, such as a CSI-RS or a synchronization signal block (SSB) for demodulation of a NR-PDSCH or NR-PDCCH. Xi, [0086].	In one embodiment, there may be a DL beam indication for NR-PDSCH. An N-bit Transmission Configuration Indicator (TCI) field in DCI may be used to provide a spatial QCL reference to a DL RS (e.g., CSI-RS or single side band (SSB) to aid in the demodulation of NR-PDSCH and/or NR-PDCCH. Xi-Provisional, [0081].
[S]cheduling offset or scheduling delay of the corresponding NR-PDSCH allocation Xi, [0087]	[S]cheduling offset or scheduling delay of the corresponding NR-PDSCH allocation Xi-Provisional, [0082]
[S]cheduling offset or time offset for the reception or demodulation of NR-PDSCH Xi, [0090]	[S]cheduling offset or time offset for the reception and demodulation of NR-PDSCH. Xi-Provisional, [0084]
[T]hreshold K, which may be an estimated time duration that the WTRU needs to finish ... beam switching from a current Rx beam to a new Rx beam, or the like. Threshold K may also be a value of estimated time duration for a WTRU performing TCI decoding, blind decoding, RF tuning, beam switching, or the like if a new Rx beam is needed. Xi, [0088]-[0089].	The scheduling offset may be smaller, equal, or larger than a pre-specified or configured threshold K, which may be an estimated time duration that the WTRU needs to finish TCI decoding, RF tuning, and beam switching from a current RX beam to a new RX beam if a new RX beam is configured for NR-PDSCH. The threshold value K may be an estimate time duration for a WTRU performing TCI decoding, RF tuning, and beam switching if a new RX beam is needed.

Threshold K may depend on WTRU capability... WTRU capabilities may include ... WTRU processing time for beam switching, ... number of panels equipped and used simultaneously/non-simultaneously, fixed Rx beam configurations, or the like. A WTRU may report the WTRU capability to assist a network device, gNB, TRP, or the like to configure an appropriate scheduling offset or time offset for the reception or demodulation of NR-PDSCH. Xi, [0090].	Xi-Provisional, [0083]-[0084]. The time length expressed by the threshold value K may depend on one or more of the following factors: WTRU capability; deployment scenarios, WTRU supported/used numerologies (i.e., where different values of K may be needed for different numerologies); WTRU service type such as eMBB, URLLC, MTC, or the like (e.g., URLLC may require smaller value of K than eMBB use case for a low latency requirement); and/or QoS requirements. The WTRU capabilities may include, but are not limited to, WTRU processing time for DCI reception and decoding (e.g., a different WTRU may have different decoding capability); WTRU processing time for beam switching; WTRU RF chain tuning time; number of panels equipped and used simultaneously/nonsimultaneously; a WTRU only implementing a fixed Rx beam; and/or a WTRU reporting the WTRU capability to assist gNB or TRP to configure the appropriate scheduling offset or time offset for the reception and demodulation of NR-PDSCH. Xi-Provisional, [0084].
In certain configurations, a WTRU may be configured with one or more values of threshold K. The one or more values of threshold K may be pre-specified or configured for different types of service, such as URLLC or eMBB. One or more threshold Ks may be also used simultaneously,	In another approach, a WTRU may be configured with multiple values of K, which may be pre-specified and configured for different types of service (e.g., URLLC or eMBB), and multiple Ks may be used simultaneously or alternatively. For example, a WTRU may support

persistently, semi-persistently, alternately, or the like. For example, a WTRU may be capable of multiple types of service, such as URLLC or eMBB, simultaneously or alternately where one or more thresholds K may be accordingly configured for multiple services. Each type of service may have similar or different threshold K values. Xi, [0092].	multiple types of service (e.g., URLLC, eMBB) simultaneously or alternatively, then multiple Ks may be accordingly configured for multiple services, which may be the same or different values. Xi-Provisional, [0087].
Threshold K may be configured, selected, determined, calculated, or the like by a network device, gNB, TRP, WTRU, mobile device, or the like. Xi, [0093].	As discussed here, the threshold value K may be decided by the network (gNB/TRP) and/or WTRU in a number of different methods. Xi-Provisional, [0088].
The network may also configure a WTRU with several values of threshold K and the WTRU may select or determine a value of threshold K based on network configurations. Each threshold K may be associated with possible conditions, such as when the value of threshold K is the nearest rounded integer of time by combining TCI decoding time and beam switching time. Xi, [0094].	Another example, the network may configure a WTRU with several optional values of K (each option may be bundled with possible conditions, such as when the value K is the nearest rounded integer milliseconds by combining TCI decoding time and beam switching time), and the WTRU may select or determine a value K from multiple K values based on network configurations. Xi-Provisional, [0089].
In addition, the similar or different threshold K value may be configured to a WTRU based on WTRU capability, WTRU operation, WTRU states, current WTRU numerology, custom WTRU settings, or the like. Xi, [0095].	In another method, the same or different threshold K value may be configured to a WTRU based on one or more factors such as WTRU capability, WTRU operating scenarios, WTRU currently used numerology, WTRU current use case, etc. Xi-Provisional, [0091].
Tables 2 and 3 of Xi show different values of threshold K, depending on component carrier (CC) used, subcarrier	Tables 2 and 3 of Xi-Provisional show different values of threshold K, depending on component carrier (CC)

spacing (SCS), and bandwidth part (BWP).

Xi, [0097] (“Table 2 and Table 3 are examples of determining or selecting threshold K.”), [0099].

TABLE 2

Beam Indication Latency	Units	60 kHz SCS	120 kHz SCS	60 kHz SCS	120 kHz SCS	...
		CC1/BWP1		CC2/BWP2		
Low Latency	Symbols or Slots	Value 1	Value 4	Value 7	Value 10	
Medium Latency	Symbols or Slots	Value 2	Value 5	Value 8	Value 11	
High Latency	Symbols or Slots	Value 3	Value 6	Value 9	Value 12	

TABLE 3

Beam Indication Latency	Units	60 kHz SCS CC1/BWP1	120 kHz SCS CC1/BWP1	60 kHz SCS CC2/BWP2	120 kHz SCS CC2/BWP2	...
Low Latency	Symbols or Slots	Value 13	Value 16	Value 19	Value 22	
Medium Latency	Symbols or Slots	Value 14	Value 17	Value 20	Value 23	
High Latency	Symbols or Slots	Value 15	Value 18	Value 21	Value 24	

A WTRU may dynamically switch operation capabilities. For example, for saving energy, a WTRU may switch from advanced mode to baseline mode. A WTRU may initiate or be configured by a network device, gNB, TRP, or the like to work from above 6 GHz to below 6 GHz with SCS switching available from 60/120 kHz to 15/30 kHz.

Xi, [0100].

Beam switching time may be equal to 0 if no beam switching is needed or a non-zero value if beam switching is needed.

Xi, [0104].

used, subcarrier spacing (SCS), and bandwidth part (BWP). Xi-Provisional, [0093] (“Table 2 and Table 3 are examples used for a table based scenario for determining threshold K.”).

Beam indication latency requirement (imposed by, e.g., service type, QoS, etc.)	Units	60kHz SCS	120 kHz SCS	60kHz SCS	120 kHz SCS	...
		CC1 / BWP1		CC2 / BWP2		
Low latency	Symbols or slots	Value 1	Value 4	Value 7	Value 10	
Medium latency	Symbols or slots	Value 2	Value 5	Value 8	Value 11	
High latency	Symbols or slots	Value 3	Value 6	Value 9	Value 12	

Table 2 Threshold-Sched-Offset value for baseline WTRU (WTRU category I)

Beam indication latency requirement	Units	60kHz SCS	120 kHz SCS	60kHz SCS	120 kHz SCS	...
		CC1 / BWP1		CC2 / BWP2		
Low latency	Symbols or slots	Value 13	Value 16	Value 19	Value 22	
Medium latency	Symbols or slots	Value 14	Value 17	Value 20	Value 23	
High latency	Symbols or slots	Value 15	Value 18	Value 21	Value 24	

Table 3 Threshold-Sched-Offset value for advanced WTRU (WTRU category II)

Due to a variety of reasons, a WTRU may dynamically be switching its operation capabilities. For example, for saving energy consumption, a WTRU may switch from advance mode to baseline mode. A WTRU may initiate or be indicated by NW (gNB/TRP) to work from above 6 GHz to below 6 GHz, and the supported SCS may be switching from 60/120 khz to 15/30 khz.

Xi-Provisional, [0097].

The beam switching time may be equal to 0 if no beam switching is needed or non-zero value if beam switching is needed.

Xi, [0103].

A WTRU may receive the scheduling offset or time offset information for PDSCH reception or demodulation after decoding the DCI from the received PDCCH. Xi, [0107].	The WTRU may receive the scheduling offset information for POSCH reception/demodulation after decoding the DCI from the received PDCCH. Xi-Provisional, [0106].
A WTRU may receive the scheduling offset or time offset information for PDSCH reception or demodulation after decoding the DCI from the received PDCCH. Xi, [0107].	The WTRU may receive the scheduling offset information for POSCH reception/demodulation after decoding the DCI from the received PDCCH. Xi-Provisional, [0106].
If the scheduling offset of a corresponding NR-PDSCH, that may be indicated by the scheduling assignment DCI, is equal or bigger than the threshold K, NR-PDSCH may use the beam or spatial QCL assumption indicated by the N-bit TCI in the assignment DCI. If the scheduling offset of a corresponding NR-PDSCH, that may be indicated by the assignment DCI, is smaller than the threshold K, the WTRU may apply a suitable Rx beam from the starting symbol of the scheduled NR-PDSCH. This operation may avoid loss of NR-PDSCH symbols scheduled before the threshold K. Xi, [0109].	If the scheduling offset of corresponding NR-PDSCH (indicated by the scheduling assignment DCI) is equal or bigger than the threshold value K, NR-PDSCH may use the beam (spatial QCL assumption) indicated by the N-bit TCI in the assignment DCI. If the scheduling offset of corresponding NR-PDSCH (indicated by the scheduling assignment DCI) is smaller than the threshold value K, the WTRU may apply the proper Rx beam from the starting symbol of the scheduled NR-PDSCH to avoid loss of the NR-PDSCH symbols which are scheduled before the threshold value K. Xi-Provisional, [0111].
A specific beam may be pre-configured so that the WTRU may switch to the pre-configured beam to buffer the first few symbols of a NR-PDSCH. The information for a WTRU to switch to the specific beam and the time a WTRU needs to receive and buffer on the specific beam, may be pre-	In one approach the beam may be pre-configured. For example, a specific beam may be pre-configured so that the WTRU may always switch to the pre-configured beam to buffer the first few symbols of NR-POSCH. The information concerning whether a WTRU must switch to that beam and

configured and known to the WTRU in advance. Xi, [0110].	for how long a WTRU needs to receive and buffer on that specific beam, may be pre-configured and known to the WTRU in advance. Xi-Provisional, [0112].
A WTRU may use a semi-persistent beam, such as when a Tx or Rx beam for NR-PDSCH changes slowly or infrequently making indication of the beam in every scheduled NR-PDSCH unnecessary. As an example, a spatial QCL assumption or a beam sent to a WTRU at timeslot t1 may be reused by the WTRU to receive a plurality of subsequent scheduled NR-PDSCH allocations until a condition is satisfied. For low overhead, a spatial QCL assumption may be indicated to the WTRU by using DCI or TCI. ... Another condition may be a timer configured with each spatial QCL assumption. When the timer expires, spatial QCL assumptions may become invalid. A new spatial QCL assumption may also be a condition indicated or configured that may directly overwrite the old spatial QCL assumption. Xi, [0112].	Another mechanism may use a semi-persistent beam. TX/RX beam for NR-PDSCH may not change dynamically and quickly that it is needed to indicate the beam in every NR-PDSCH scheduling. The spatial QCL assumption (or a beam) sent to a WTRU at time/slot t1 may be reused by the WTRU to receive all subsequent scheduled NR-PDSCH allocations until a specific condition is satisfied. Note that the spatial QCL assumption may be indicated to the WTRU by using DCI/TCI ... a timer may be configured with each spatial QCL assumption, and when the timer is expired, the spatial QCL assumptions becomes invalid; a new spatial QCL assumption is indicated/configured, which may directly overwrite the old spatial QCL assumption. Xi-Provisional, [0116].
A persistent duration may be related to WTRU speed and configured or indicated as a certain period or a timer in a DCI, a MAC-CE message or signal, a RRC message, or the like. Xi, [0113].	The persistence duration may be related to the WTRU's moving speed and configured/indicated as a certain period or a timer in DCI or MAC-CE or RRC message. Xi-Provisional, [0117].
Xi then provides several alternatives for selecting a “suitable Rx beam” that does not involve decoding the DCI, including the use of a “preconfigured beam” or a “default beam,” Xi, [0110],	“beam may be pre-configured” or a “default beam” [0112] or based on “pre-defined mechanisms” [0113]

or a beam “based on pre-defined rules,” Xi, [0113].	
“the DL active BWP for a WTRU changes dynamically,” and “the UL active BWP for a WTRU changes dynamically,” Xi, [0205]	“In another case, as the DL active bandwidth part (BWP) for a WTRU changes dynamically... In another case, as the UL active BWP for a WTRU changes dynamically...” Xi-Provisional, [0207]-[0208].

X. SUPPORT IN XI-PROVISIONAL FOR CLAIM IN XI

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

Claim in Xi	Support in Xi-Provisional
8. A method performed by a wireless transmit/receive unit (WTRU), the method comprising:	“FIG. 1B is a system diagram illustrating an example wireless transmit/receive unit (WTRU) that may be used within the communications system illustrated in FIG. 1A according to an embodiment;” Xi-Provisional, [0005]. Steps performed in a WTRU are demonstrated below.
monitoring, by the WTRU, a plurality of configured control resource sets (CORESETs) to receive a downlink control information (DCI) on a physical downlink control channel (PDCCH), wherein the DCI includes scheduling information for a data transmission on a physical downlink shared channel (PDSCH);	In one approach, if multiple CORESETs are configured to monitor for NR-PDSCH scheduling and the CORESETs are associated with the same beam (e.g., the CORESETs are QCL-ed with the same downlink reference signal), the default beam for a NR-PDSCH reception may be based on the beam used for CORESETs. The offset value between a CORESET and its associated NR-PDSCH may be the same irrespective of the CORESET number in which the WTRU received the scheduling DCI. Xi-Provisional, [0145].

determining, by the WTRU, a default beam of a reference CORESET from among the configured CORESETs, wherein the reference CORESET is determined based on at least one of a slot, a slot number, configured CORESETs monitored in the slot, and CORESET time location with respect to the PDSCH.

In another approach, if the CORESETs are associated with more than one beam (e.g., QCL-ed with more than one downlink signals or downlink reference signals), the default beam for a NR-PDSCH reception may be based on one or more scenarios. In one scenario, a reference CORESET may be defined or determined within the configured CORESETs, wherein the QCL parameters (or a subset of QCL parameters) for the reference CORESET may be used as a default beam for the NR-PDSCH reception. For example, the QCL parameters for NR-PDSCH reception may be the same as the QCL parameters of the reference CORESET. The QCL assumption for the reference CORESET (e.g., spatial Rx parameter) may be reused for the NR-PDSCH reception in the slot. Also, the reference CORESET may be different in each slot. For example, a first CORESET in the configured CORESETs may be used or determined as the reference CORESET in a slot and a second CORESET in the configured CORESETs may be used or determined as the reference CORESET in another slot. When the reference CORESET is changed across slots, the reference CORESET may be cyclically switched among the configured CORESETs. Additionally, the reference CORESET may be a predefined location within the configured CORESETs irrespective of the slot, and the configured CORESETs may be different based on the slot number.

	Xi-Provisional, [0146]. In another scenario, the CORESET located in the latest time location (e.g., closest to the NR-PDSCH region) within the configured CORESETs may be used or determined as a reference CORESET. Xi-Provisional, [0147]. In another scenario, the reference CORESET within the configured CORESETs may be determined implicitly based on at least one of following: system parameters (e.g., numerology, cell-ID, etc.); WTRU-specific parameters (e.g., WTRU-ID (e.g., C-RNTI), scrambling ID, etc.); and/or timing/location parameters (e.g., slot number, frame number, radio frame number, bandwidth part number, etc.). Xi-Provisional, [0149].
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XI. CONCLUSION

172. 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. 14, 2023

Date: _____



Digitally signed by

Zhi Ding

Date: 2023.03.14

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