UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

APEX BEAM TECHNOLOGIES LLC,
Patent Owner

Case IPR2023-00601
Patent No. 10,568,113

PETITION FOR *INTER PARTES* REVIEW

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1. Independent Claim 1 14

a. [1pre]: “A method in a User Equipment (UE) for wireless communication, comprising:” 14

b. [1a]: “receiving a target radio signal;” 17

c. [1b]: "transmitting a first radio signal on a first channel;" 18

d. [1c]: "transmitting a second radio signal on a second channel; and" 20

e. [1d]: "monitoring a third radio signal in a first time window;" 21

f. [1e]: "wherein a measurement for the target radio signal obtains a target measurement value, the target measurement value, when higher than a target threshold is used for triggering the transmission of the first radio signal and the second radio signal;" 23

g. [1f]: "a time resource occupied by the first radio signal is used for determining the start time of the first time window;" 30

h. [1g]: "a time domain resource occupied by the first radio signal is used for determining a second time window," 31

i. [1h]: "a time domain resource occupied by the second radio signal is within the second time window, and the second time window is within the first time window;" 33

j. [1i]: "a time domain resource occupied by the second radio signal is used for determining a third time window, and the end time of the third time window is the end time of the first time window; and" 34

k. [1j]: "the second time window and the third time window have overlapped time domain resource(s)." 35

2. Claim 2 36

a. [2a]: "The method according to claim 1, wherein at least one signal of the following set of signals: {the first radio signal, the second radio signal} is used for determining a multi-antenna related transmitting of the third radio signal; or,".....36

b. [2b]: "the first radio signal and the second radio signal together are used for determining the multi-antenna related transmitting of the third radio signal.".....39

3. Claim 3.....39

a. "The method according to claim 1, wherein the first channel is a first type of physical layer channel, the second channel is a second type of physical layer channel, and the first type of physical layer channel and the second type of physical layer channel are two different types of physical layer channels.".....39

4. Claim 4.....40

a. "The method according to claim 1, wherein the first channel is a physical layer control channel.".....40

5. Claim 5.....40

a. [5a]: "The method according to claim 1, wherein the first radio signal is used for determining a first antenna port group, and the first antenna port group is spatially related to an antenna port group used for transmitting the third radio signal, the being spatially related refers to being Quasi Co-Located ("QCL"); or,".....40

b. [5b]: "the first time window is divided into a second time interval and a third time interval, the second time interval is before the third time interval, the third time interval is behind a time domain resource occupied by the second radio

signal, the first radio signal is used for determining a second antenna port group, in the second time interval, the second antenna port group is spatially QCL with an antenna port group used for transmitting the third radio signal in the second time interval, the second radio signal is used for determining a third antenna port group; in the third time interval, the third antenna port group is spatially QCL with an antenna port group used for transmitting the third radio signal in the third time interval." 42

6. Independent Claim 6 42

a. [6pre]: "A method in a base station device for wireless communication, comprising:" 42

b. [6a]: "transmitting a target radio signal;" 43

c. [6b]: "receiving a first radio signal on a first channel;" 43

d. [6c]: "receiving a second radio signal on a second channel; and" 44

e. [6d]: "transmitting a third radio signal in a first time window;" 44

f. [6e]: "wherein a measurement for the target radio signal obtains a target measurement value, the target measurement value, when higher than a target threshold, is used for triggering the transmission of the first radio signal and the second radio signal;" 45

g. [6f]: "a time resource occupied by the first radio signal is used for determining the start time of the first time window;" 45

h. [6g]: “a time domain resource occupied by the first radio signal is used for determining a second time window,”.....45

i. [6h]: “a time domain resource occupied by the second radio signal is within the second time window, and the second time window is within the first time window;”.....45

j. [6i]: “a time domain resource occupied by the second radio signal is used for determining a third time window, and the end time of the third time window is the end time of the first time window; and”.....45

k. [6j]: “the second time window and the third time window have overlapped time domain resource(s).”.....45

7. Claim 7.....46

a. Claim [7a]: “The method according to claim 6, wherein at least one signal of the following set of signals: {the first radio signal, the second radio signal} is used for determining a multi-antenna related transmitting of the third radio signal; or,”.....46

b. Claim [7b]: “the first radio signal and the second radio signal together are used for determining the multi-antenna related transmitting of the third radio signal.”.....46

8. Claim 8.....47

a. “The method according to claim 6, wherein the first channel is a first type of physical layer channel, the second channel is a second type of physical layer channel, and the first type of physical layer channel and the second type of physical layer channel are two different types of physical layer channels.”.....47

9. Claim 9 47

a. "The method according to claim 6, wherein the first channel is a physical layer control channel." 47

10. Claim 10 48

a. [10a]: "The method according to claim 6, wherein the first radio signal is used for determining a first antenna port group, and the first antenna port group is spatially related to an antenna port group used for transmitting the third radio signal, the being spatially related refers to being Quasi Co-Located ("QCL"); or," 48

b. 10[b]: "the first time window is divided into a second time interval and a third time interval, the second time interval is before the third time interval, the third time interval is behind a time domain resource occupied by the second radio signal, the first radio signal is used for determining a second antenna port group, in the second time interval, the second antenna port group is spatially QCL with an antenna port group used for transmitting the third radio signal in the second time interval, the second radio signal is used for determining a third antenna port group; in the third time interval, the third antenna port group is spatially QCL with an antenna port group used for transmitting the third radio signal in the third time interval." 48

11. Independent Claim 11 49

a. [11pre]: "A UE for wireless communication, comprising:" 49

b. [11a]: "a first receiver module, to receive a target radio signal;" 52

c. [11b]: "a second transmitter module, to transmit a first radio signal on a first channel;" 53

d. [11c]: "a third transmitter module, to transmit a second radio signal on a second channel; and" 54

e. [11d]: "a fourth receiver module, to monitor a third radio signal in a first time window;" 55

f. [11e]: "wherein a measurement for the target radio signal obtains a target measurement value, the target measurement value, when higher than a target threshold, is used for triggering the transmission of the first radio signal and the second radio signal;" 56

g. [11f]: "a time resource occupied by the first radio signal is used for determining the start time of the first time window;" 56

h. [11g]: "a time domain resource occupied by the first radio signal is used for determining a second time window," 56

i. [11h]: "a time domain resource occupied by the second radio signal is within the second time window, and the second time window is within the first time window;" 56

j. [11i]: "a time domain resource occupied by the second radio signal is used for determining a third time window, and the end time of the third time window is the end time of the first time window; and" 56

k. [11j]: "the second time window and the third time window have overlapped time domain resource(s)." 56

12. Claim 12 57

a. [12a]: "The UE according to claim 11, wherein at least one signal of the following set of signals: {the first radio signal, the second radio signal} is used for determining a multi-antenna related transmitting of the third radio signal; or,".....57

b. [12b]: "the first radio signal and the second radio signal together are used for determining the multi-antenna related transmitting of the third radio signal."....57

13. Claim 13.....58

a. "The UE according to claim 11, wherein the first channel is a first type of physical layer channel, the second channel is a second type of physical layer channel, and the first type of physical layer channel and the second type of physical layer channel are two different types of physical layer channels."....58

14. Claim 14.....58

a. "The UE according to claim 11, wherein the first channel is a physical layer control channel."....58

15. Claim 15.....59

a. [15a]: "The UE according to claim 11, wherein the first radio signal is used for determining a first antenna port group, and the first antenna port group is spatially related to an antenna port group used for transmitting the third radio signal, the being spatially related refers to being Quasi Co-Located ("QCL"); or,".....59

b. [15b]: "the first time window is divided into a second time interval and a third time interval, the second time interval is before the third time interval, the third time interval is behind a time domain resource occupied by the second radio

signal, the first radio signal is used for determining a second antenna port group, in the second time interval, the second antenna port group is spatially QCL with an antenna port group used for transmitting the third radio signal in the second time interval, the second radio signal is used for determining a third antenna port group; in the third time interval, the third antenna port group is spatially QCL with an antenna port group used for transmitting the third radio signal in the third time interval." 59

16. Independent Claim 16 60

a. [16pre]: "A base station device for wireless communication, comprising:" 60

b. [16a]: "a first transmitter module, to transmit a target radio signal;" 62

c. [16b]: "a second receiver module, to receive a first radio signal on a first channel;" 62

d. [16c]: "a third receiver module, to receive a second radio signal on a second channel; and" 62

e. [16d]: "a fourth transmitter module, to transmit a third radio signal in a first time window;" 63

f. [16e]: "wherein a measurement for the target radio signal obtains a target measurement value, the target measurement value, when higher than a target threshold, is used for triggering the transmission of the first radio signal and the second radio signal;" 63

g. [16f]: "a time resource occupied by the first radio signal is used for determining the start time of the first time window;" 64

h. [16g]: "a time domain resource occupied by the first radio signal is used for determining a second time window,"....64

i. [16h]: "a time domain resource occupied by the second radio signal is within the second time window, and the second time window is within the first time window;"....64

j. [16i]: "a time domain resource occupied by the second radio signal is used for determining a third time window, and the end time of the third time window is the end time of the first time window; and"....64

k. [16j]: "the second time window and the third time window have overlapped time domain resource(s)."....64

17. Claim 17....65

a. [17a]: "The base station device according to claim 16, wherein at least one signal of the following set of signals: {the first radio signal, the second radio signal} is used for determining a multi-antenna related transmitting of the third radio signal; or,"....65

b. 17[b]: "the first radio signal and the second radio signal together are used for determining the multi-antenna related transmitting of the third radio signal."....65

18. Claim 18....65

a. "The base station device according to claim 16, wherein the first channel is a first type of physical layer channel, the second channel is a second type of physical layer channel, and the first type of physical layer channel and the second type of physical layer channel are two different types of physical layer channels."....65

19. Claim 19 66

a. "The base station device according to claim 16, wherein the first channel is a physical layer control channel." 66

20. Claim 20 66

a. [20a]: "The base station device according to claim 16, wherein the first radio signal is used for determining a first antenna port group, and the first antenna port group is spatially related to an antenna port group used for transmitting the third radio signal, the being spatially related refers to being QCL; or," 66

b. [20b]: "the first time window is divided into a second time interval and a third time interval, the second time interval is before the third time interval, the third time interval is behind a time domain resource occupied by the second radio signal, the first radio signal is used for determining a second antenna port group, in the second time interval, the second antenna port group is spatially QCL with an antenna port group used for transmitting the third radio signal in the second time interval, the second radio signal is used for determining a third antenna port group; in the third time interval, the third antenna port group is spatially QCL with an antenna port group used for transmitting the third radio signal in the third time interval." 67

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PETITIONER'S EXHIBIT LIST

Exhibit	Description
Ex. 1001	U.S. Patent No. 10,568,113 to Zhang ("'113 patent")
Ex. 1002	"Xia" Declaration of Dr. Harry Bims, Ph.D. ("Bims")
Ex. 1003	Prosecution History of the '113 patent (downloaded from the USPTO's Patent Center Website)
Ex. 1004	U.S. Patent Application Publication No. 2019/0053294 to Xia et al., published February 14, 2019 ("*Xia*")
Ex. 1005	U.S. Patent Application Publication No. 2015/0141026 to Jover, published May 21, 2015 ("*Jover*")
Ex. 1006	3GPP TSG RAN WG1 NR Ad-Hoc#2, Qingdao, P.R. China 27th – 30th June 2017, published in 3GPP website (https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_AH/NR_AH_1706/Docs) on June 16, 2017 ("*R1-1710596*")
Ex. 1007	U.S. Patent Publication No. 2018/0367374 to Liu et al., published December 20, 2018 ("*Liu*")
Ex. 1008	Reserved
Ex. 1009	Raghav Pandey, Ashwani Awasthi, and Vikas Srivastava, "Comparison between Bit Error Rate And Signal To Noise Ratio in OFDM Using LSE Algorithm," in Proceedings of the Conference on Advances in Communication and Control Systems (CAC2S 2013), pp. 463-466, Atlantis Press 2013.
Ex. 1010	Screen shot of 3GPP Portal showing the upload time of *R1-1710596* on the 3GPP website.
Ex. 1011	International Patent Publication No. WO 2017/024516 A1 to Lu et al., published February 16, 2017 ("*Lu*")
Ex. 1012	U.S. Provisional Application No. 62/543,765 to Xia et al. ("*Xia Provisional*")
Ex. 1013	U.S. Patent No. 6,185,432 to Vembu, published February 6, 2001 ("*Vembu*")
Ex. 1014	U.S. Provisional Application No. 62/521,170 to Liu et al. ("*Liu Provisional*")
Ex. 1015	Printout of https://www.atlantis-press.com/proceedings/cac2s-13/6357
Ex. 1016	3GPP Declaration of Friedhelm Rodermund

Exhibit	Description
Ex. 1017	*Apex Beam Technologies LLC v. Samsung Electronics Co. Ltd. et al.*, No. 2:22-cv-00188-JRG, Dkt. No. 1, Complaint for Patent Infringement (E.D. Tex. June 1, 2022)
Ex. 1018	United States District Courts – National Judicial Caseload Profile, *available at* https://www.uscourts.gov/sites/default/files/fcms_na_distprofile0630.2022_0.pdf (retrieved February 5, 2023)
Ex. 1019	*Apex Beam Technologies LLC v. ZTE Corp.*, No. 2:22-cv-00031-JRG-RSP, Dkt. No. 37, Docket Control Order (E.D. Tex. Feb. 2, 2023) (consolidated with *Apex Beam Technologies LLC v. Samsung Electronics Co. Ltd. et al.*, No. 2:22-cv-00188-JRG)
Ex. 1020	*Apex Beam Technologies LLC v. Samsung Electronics Co. Ltd. et al.*, No. 2:22-cv-00188-JRG, Plaintiff's Infringement Contentions Cover Pleading (January 5, 2023)
Ex. 1021	3GPP TSG RAN WG1 NR Ad-Hoc#2, R1-1710078, Qingdao, P.R. China 27th – 30th June 2017, published in 3GPP website (https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_AH/NR_AH_1706/Docs) on June 16, 2017 ("*R1-1710078*").
Ex. 1022	3GPP TSG RAN WG1 #87ah-NR, R1-1700771, Spokane, WA, USA, 16th – 20th January, 2017, published in 3GPP website (https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_AH/NR_AH_1701/Docs/) on January 10, 2017 ("*R1-1700771*").

I. PRELIMINARY STATEMENT

Petitioner Samsung Electronics Co., Ltd., and Samsung Electronics America, Inc. (collectively "Samsung") requests *inter partes* review of U.S. Patent No. 10,568,113 (Ex. 1001), assigned to Patent Owner Apex Beam Technologies LLC, and cancellation of claims 1-20.

The challenged claims are directed to methods and devices for wireless communication, and relate to a particular procedure of sending two beam recovery requests from a user equipment (UE) to a base station through two different channels. This same procedure, however, was proposed to a standards organization (3GPP) and published at least two months before the earliest claimed priority date of the '113 patent. In addition, multiple patent applications were also filed on this same procedure before the earliest claimed priority date of the '113 patent, including prior art U.S. Patent Application Publication No. 2019/0053294 to Xia et al. (Ex. 1004).

As set forth below, claims 1-20 would have been obvious based on *Xia* alone or in combination with U.S. Patent Application Publication No. 2015/0141026 to Jover ("*Jover*") (Ex. 1005). The Examiner did not consider this prior art during examination. The Board should thus institute review and cancel all challenged claims.

II. PRIOR ART BACKGROUND

A. General Overview of Multiple-Input and Multiple-Output (MIMO) and Antenna Beam Failure Recovery

One of the aims of wireless communications research is to improve the speed, reliability, and coverage area of wireless signals transmitted over the air. Bims, ¶41. One technique that is being used to achieve these objectives is multiple-input and multiple-output (MIMO) radio communications. *Id*. MIMO is a physical layer technique that has been well known for many years, where user equipment (UE) and a base station each transmit and receive wireless signals using multiple antennas. *Id*.

The multiple antennas are controlled in such a way that they collectively generate one or more antenna patterns created by the multiple antennas, called beams. *Id.*, ¶42. These beams direct the energy of wireless radio signals in particular directions and even allow for multiple radio signals to be transmitted and received simultaneously. *Id*. Due to time-varying fluctuations in the radio frequency channel conditions, the quality of each beam (and thus, the quality of communication between the UE and the base station) may vary over time based on a number of factors. *Id*.

When the quality of the beam is insufficient, a beam failure may be detected. *Id*., ¶43. To resolve the beam failure, the UE and the base station may

communicate to change or adjust their beam patterns and thereby improve the quality of communication between the UE and the base station. *Id*. This process is known as beam failure recovery. *Id*.

Beam failure recovery was well known in the art before the earliest claimed priority date of the '113 patent, August 11, 2017.[1] *Id*., ¶44. For example, International Patent Publication No. WO 2017/024516, filed on August 11, 2015 ("*Lu*") (Ex. 1011), discloses the recovery from beam failure in a wireless access network, where a beamforming technique is used in communication between network elements. *Lu*, Abstract; Bims, ¶44. Specifically, *Lu* discloses sending a notification of a beam failure from the UE to an access node (i.e., base station), and in response, sending information about a new serving beam from the access node to the UE. *Lu*, [058]-[067], FIG. 3; Bims, ¶44.

B. 3GPP Proposed Standard

The 3rd Generation Partnership Project (3GPP) is a well-known standards organization that helps to create standards for telecommunications technologies. Bims, ¶¶45-46. Generally, the 3GPP holds working group meetings several times a year to propose and discuss new standards and/or changes to exisiting standards.

[1] Petitioner reserves the right to challenge the priority date here and/or in other proceedings.

Id. The 3GPP materials are generally made available to the public on the 3GPP website. *Id*.

During one particular working group meeting (3GPP TSG RAN WG1 NR) held in Qingdao, China, between June 27-30, 2017, the working group discussed the following proposal:

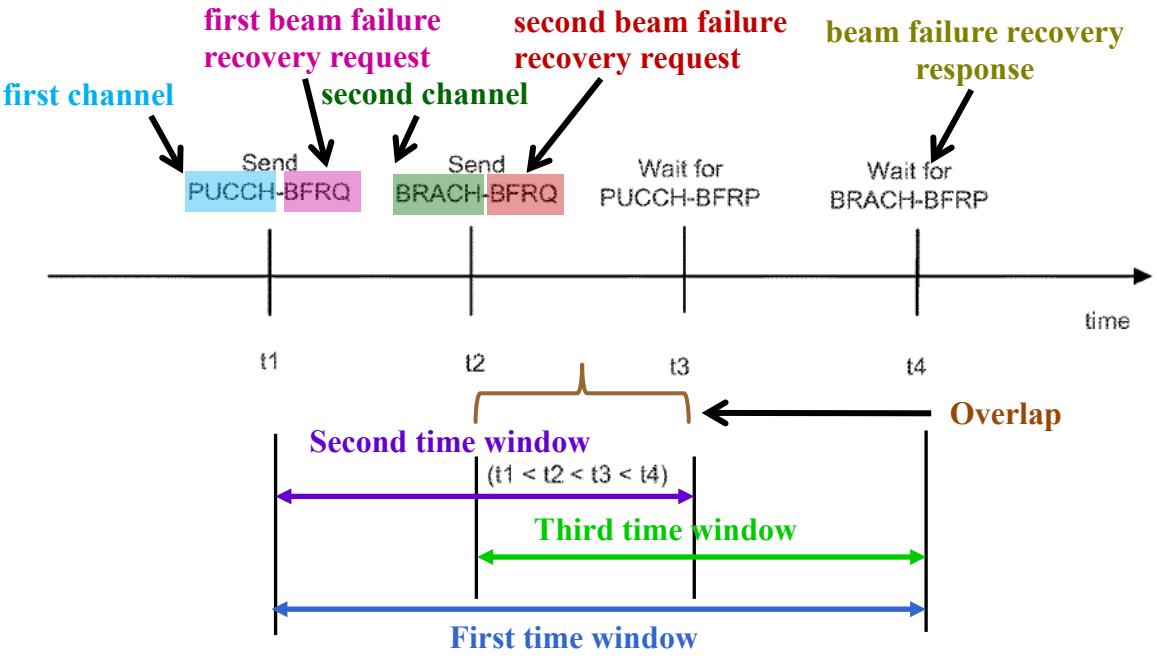
> Proposal 7: A UE can transmit additional beam failure recovery request through PUCCH after it first transmits using PRACH and before it receives the corresponding Message 2.

Ex. 1006, p. 4; Rodermund, ¶¶46-50; Bims, ¶47.

In other words, "Proposal 7" describes a technique where a UE can send a second beam failure recovery request through a second channel, the Physical Uplink Control Channel (PUCCH), before receiving a response (the corresponding Message 2) to a first beam failure recovery request through a first channel, the Physical Random Access Channel (PRACH). Bims, ¶48. The meeting document (*RI-1710596*) was made publicly available on the 3GPP website on June 16, 2017. *See* Ex. 1010 at 23; Rodermund, ¶¶46-50. Two months later, the alleged priority application of the '113 patent was filed on August 11, 2017, describing "Proposal 7" from the *R1-1710596* document and other already well-known concepts. Bims, ¶48.

C. Patent Literature Implementing Proposed Standard

Between June 16, 2017, and August 11, 2017, several patent applications were filed on "Proposal 7." For example, *Xia* discloses a method in a UE where multiple beam failure recovery requests are transmitted to a base station. *Xia*, [0091]; *Xia Provisional*, [0084]. In particular, the UE first monitors a reference signal (beam failure detection RS) to assess whether a beam failure trigger condition has been met. *Xia*, [0076]; *Xia Provisional*, [0062]. If the condition is met, the UE transmits a **first beam failure recovery request** to the base station using a **first channel** (e.g., **PUCCH**), and subsequently transmits a **second beam failure recovery request** to the base station using a **second channel** (e.g., **PRACH**). *Xia*, [0091]-[0093], [0097]-[0103], [0105]-[0106], FIGS. 6B, 7A-7B; *Xia Provisional*, [0084]-[0085], FIG. 6. *Xia* also discloses that the UE waits for a **beam failure recovery response** to the two beam failure recovery requests, at t3 or t4. *Xia*, [0102]; *Xia Provisional*, [0084]-[0085], FIG. 6.



Xia, FIG. 6B (annotated); *Xia Provisional*, FIG. 6.

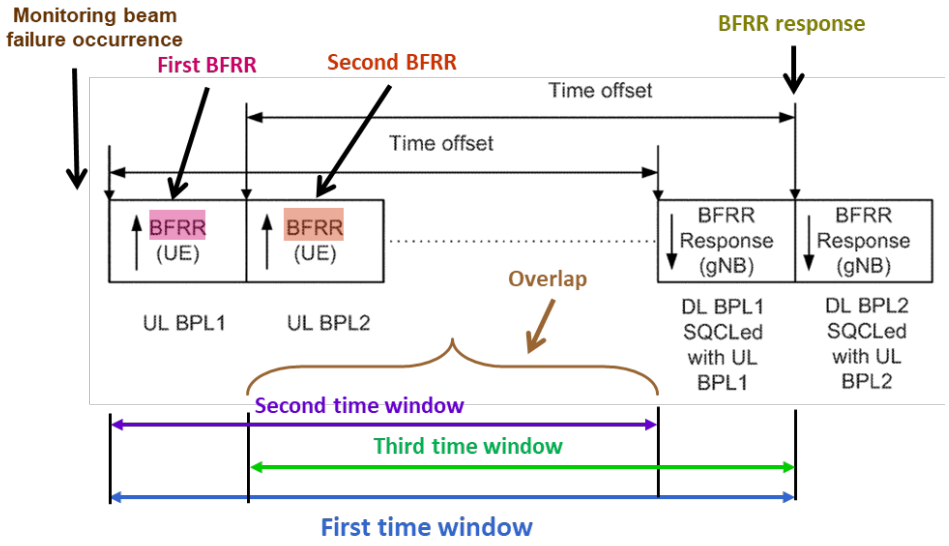
Thus, as shown in annotated FIG. 6B above, the UE waits for the response to the beam failure recovery requests within a time window starting from t1 and ending at t4, i.e., a **first time window**. *Xia*, [0102], [0084]; *Xia Provisional*, [0084]-[0085], FIG. 6. As shown, a response time window associated with the first beam failure recovery request (i.e., a **second time window**) and a response time window associated with the second beam failure recovery request (i.e., a **third time window**) have overlapped time domain resource(s). Bims, ¶¶50-52.

Xia is analogous art to the '113 patent because *Xia*, like the '113 patent, is directed to "wireless communication networks" that include methods for

"recovering from a beam failure between user equipment and a base station." *Xia*, [0002]; *Xia Provisional*, [0001]; '113 patent, 1:16-59; Bims, ¶53.

As another example, *Liu*[2] similarly discloses a method for beam failure recovery in user equipment. *Liu*, [0005]; *Liu Provisional*, [0004]. In particular, the UE first monitors a reference signal and determines whether a beam failure has occurred. If a beam failure has occurred, the UE transmits a **first beam failure recovery request (BFRR)** to the base station using a first channel (e.g., PUCCH), and subsequently transmits a **second BFRR** to the base station using a second channel (e.g., PRACH). *Liu*, [0084], [0098]-[0101], FIG. 5B; *Liu Provisional*, [0062], [0073]-[0076], FIG. 5B. *Liu* also discloses that the UE monitors for a **BFRR response** to the two beam failure recovery requests. *Liu*, [0096], [0099]; *Liu Provisional*, [0071], [0074].

[2] *Liu* is prior art to the '113 patent based on its provisional filing date of June 16, 2017. 35 U.S.C. §§ 102(a)(2). Claim 1 of *Liu* is supported by at least claim 1, paragraphs [0001], [0004], [0074], [0078]-[0080], and FIGs. 5B and 6A of the *Liu Provisional* (Ex. 1014); and parallel citations to the *Liu Provisional* are provided herein for *Liu* citations. Bims, ¶¶60-61.



Liu, FIG. 5B (annotated); *Liu Provisional*, FIG. 5B.

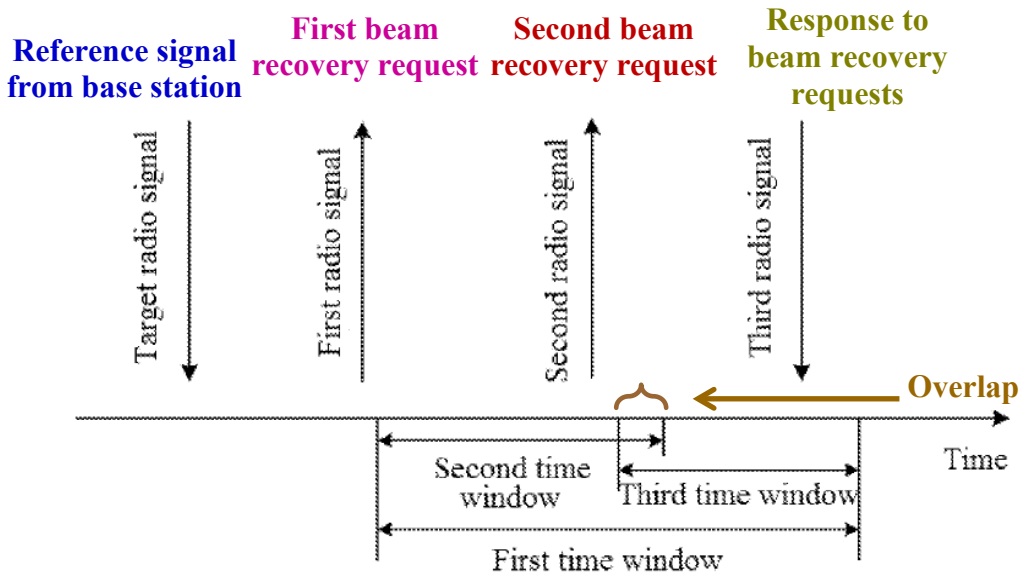
Thus, as shown in annotated FIG. 5B above, the UE monitors the response to the BFRRs within a time window from the starting of the depicted time offset for the first BFRR (a monitoring window for the first BFRR) until the end point of the depicted time offset for the second BFRR (a monitoring window for the second BFRR), i.e., a **first time window**. *Liu*, [0084], [0096]-[0099], FIG. 5B; *Liu Provisional*, [0062], [0071]-[0074]. In addition, a time window associated with the response time to the first BFRR (i.e., a **second time window**) and a time window associated with the response time to the second BFRR (i.e., a **third time window**) have overlapped time domain resource(s). *Liu*, [0084], [0096]-[0099], FIG. 5B; *Liu Provisional*, [0062], [0071]-[0074]; Bims, ¶¶56-59.

III. THE '113 PATENT

A. Alleged Invention of the '113 Patent in View of Prior Art

Viewed against this backdrop of the prior art, the '113 patent simply describes methods and devices for wireless communications between a UE and a base station that use known procedures. Just like *Xia* and *Liu*, the '113 patent addresses a beam failure between a UE and a base station in a wireless communication system. '113 patent, 1:43-52. And just like *Xia*, the '113 patent contemplates a transmission scheme in a UE, in which the UE receives a target radio signal (e.g., a **reference signal**) from the base station and determines whether a triggering condition is met. '113 patent, 5:9-18, 23:48-54, 2:23-24; Bims, ¶66.

Also, like *Xia* and *Liu*, if the triggering condition is met, the UE transmits a first radio signal (**first beam recovery request**) to the base station using a first channel (e.g., PUCCH), and subsequently transmits a second radio signal (**second beam recovery request**) using a second channel (e.g., PRACH). '113 patent, 2:1-3, 8:57-65; Bims, ¶67. The base station receives both requests and then sends a **beam recovery response**, as shown in annotated FIG. 6 below. '113 patent, 10:47-49, 10:63-64; Bims, ¶67.



'113 patent, FIG. 6 (annotated).

And just like *Xia* and *Liu*, as shown in annotated FIG. 6 above, the UE waits for the response to the beam failure recovery requests within a time window from the sending of the first beam failure recovery request to the receipt of the response to the beam failure recovery requests (i.e., a first time window). '113 patent, 2:3-7; Bims, ¶68. Further, as shown, a response time window associated with the first beam failure recovery request (i.e., a second time window) and a response time window associated with the second beam failure recovery request (i.e., a third time window) have overlapped time domain resource(s). '113 patent, 12:7-9, 22:51-56, 9:55-56; Bims, ¶68. As explained in more detail below, all of the elements claimed in the '113 patent already existed in the prior art.

B. Prosecution History

The application that issued as the '113 patent was filed on August 9, 2018, and claimed priority to a foreign application CN 201710686330.4 filed on August 11, 2017. Ex. 1003, 3, 68.

During prosecution of the '113 patent, the Examiner rejected the claims, finding that the prior art disclosed the methods and systems recited in original independent claims 1, 6, 11, and 16. Ex. 1003, 122-142. In response, the Applicant amended claims 1, 6, 11, and 16 by adding various time window limitations shown in FIG. 6 (discussed above) and argued that the prior art does not disclose that "the second time window and the third time window have overlapped time domain resource(s)." Ex. 1003, 153-154, 156-159. The Examiner subsequently allowed the claims, but again without the benefit of *Xia*, the prior art applied in this Petition, or any other reference mentioned above. Ex. 1003, 123-142, 172-182. As explained above and below, at least *Xia* discloses the exact limitations the Applicant argued were not in the prior art.

C. Claim Construction

The Board construes claims per *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). 37 C.F.R. § 42.100(b). Claims must be construed only to the extent necessary to resolve a controversy. *Nidec Motor Corp. v. Zhongshan Broad*

Ocean Motor Co., 868 F.3d 1013, 1017 (Fed. Cir. 2017). Here, no terms need construction to resolve the controversy in this forum.[3]

IV. STATEMENT OF PRECISE RELIEF REQUESTED

A. Prior Art

Ex. 1004, U.S. Patent Application Publication No. 2019/0053294 to Xia et al., published February 14, 2019, and filed on November 15, 2017 ("*Xia*"), is prior art to the '113 patent under 35 U.S.C. § 102(a)(2). *Xia* is entitled to its provisional filing date of August 10, 2017. Support for at least one claim of *Xia* is shown in the claim chart below. Bims, ¶¶54-55. In addition, support for each citation relied upon from *Xia* is set forth in the sections below.

Claim 1 of *Xia*	Support in *Xia* Provisional (Ex. 1012)
1. A method for beam failure recovery in user equipment, comprising:	"A method for beam failure recovery in user equipment, comprising:" *Xia Provisional*, claim 1; *see also id*., [0004]-[0009].
detecting a beam failure event between the user equipment and a base station;	"detecting a beam failure event between the user equipment and a base station;" *Xia Provisional*, claim 1; *see also id*., [0062].
sending a first beam failure recovery request (BFRQ) to the	"sending a first beam failure recovery request (BFRQ) to the base

[3] Petitioner reserves the right to argue in an appropriate forum that certain limitations in the challenged claims are indefinite.

base station upon detection of the beam failure event; and	station upon detection of the beam failure," *Xia Provisional*, claim 1; *see also id*., [0062], [0065], [0073]-[0077], [0084], FIGS. 5B, 6.
searching for a beam failure recovery response (BFRP) within a first response time window.	"The method of claim 1, further comprising searching for a PUCCH-beam failure recovery response (BFRP) within a response time." *Xia Provisional*, claim 2; *see also id*., [0062], [0065], [0067], [0078], [0083]-[0085], FIG. 5B, 6.

Ex. 1005, U.S. Patent Application Publication No. 2015/0141026 to Jover, published May 21, 2015 ("*Jover*"), is prior art to the '113 patent under 35 U.S.C. §§ 102(a)(1) and (a)(2). *Jover* is analogous art to the '113 patent because *Jover*, like the '113 patent, is directed to wireless communication networks that include methods for "detecting a communication impairment" between an endpoint device (UE) and a base station. *Jover*, [0001]-[0003], [0039]-[0040]; '113 patent, 1:16-59; Bims, ¶64.

B. Challenges

Ground	Challenged Claims	Basis	Prior Art
1	1-20	§ 103	*Xia*
2	1-20	§ 103	*Xia* and *Jover*

V. LEVEL OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art (POSITA) would have had at least a master's degree in electrical engineering or a similar field and at least two years of experience working with telecommunications systems, including multiple-input multiple-output (MIMO) technology. Additional relevant work experience can compensate for less education, and *vice versa*. Bims, Section IX.

VI. THE CHALLENGED CLAIMS ARE UNPATENTABLE OVER THE PRIOR ART

A. Claims 1-20 Are Obvious over *Xia* (Ground 1), or Alternatively, *Xia* in View of *Jover* (Ground 2)

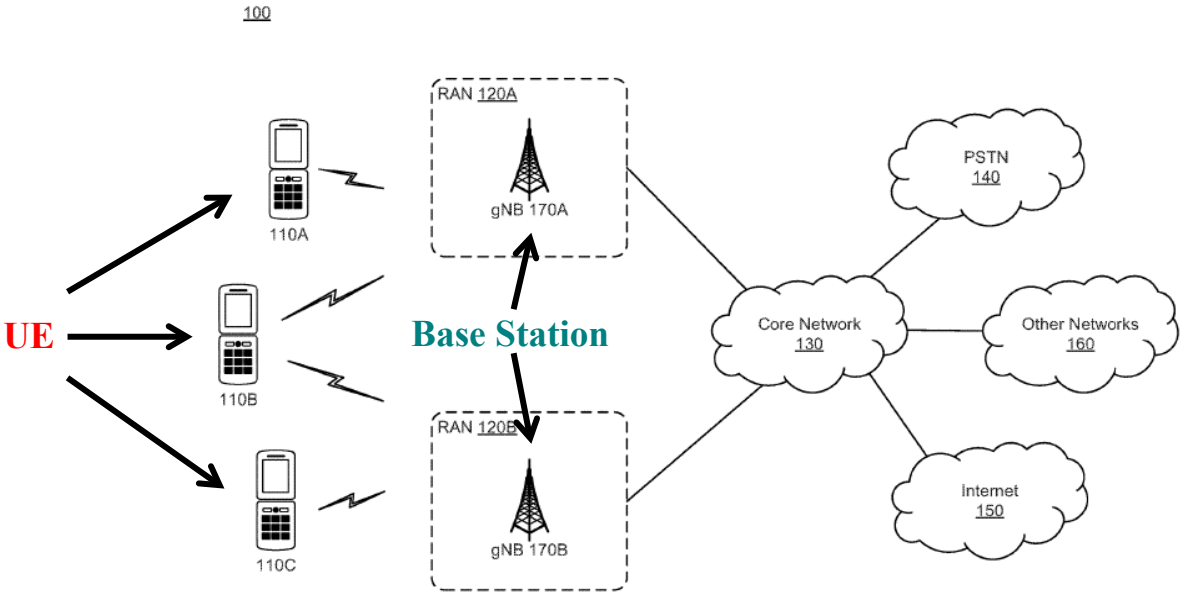
1. Independent Claim 1

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

To the extent the preamble is limiting, *Xia* discloses a method in a user equipment (UE) for wireless communication. Bims, ¶¶79-80. As shown in annotated FIG. 1 below, *Xia* discloses a wireless communication system 100 including "**user equipment 110A-110C**, radio access networks (RANs) 120A-120B, a core network 130, a public switched telephone network (PSTN) 140, the

Internet 150, and other networks 160." *Xia*, [0037];[4] *Xia Provisional*, [0025]. *Xia* explains that the "user equipment (UE) 110A-110C are configured to operate and/or communicate in the system 100. For example, the user equipment 110A-110C are configured to transmit and/or receive wireless signals or wired signals." *Xia*, [0040]; *Xia Provisional*, [0028]. *Xia* further explains that "the RANs 120A-120B include one or more base stations 170A, 170B (collectively, **base stations 170**), respectively. Each of the base stations 170 is configured to wirelessly interface with one or more of the **UEs 110A, 110B, 110C** to enable access to the core network 130, the PSTN 140, the Internet 150, and/or the other networks 160." *Xia*, [0041]; *Xia Provisional*, [0029]; Bims, ¶79.

[4] All emphasis is added unless noted otherwise. Also, all figures in this petition containing color are annotated relative to the original figures in the patent or prior art and all text in color is added.

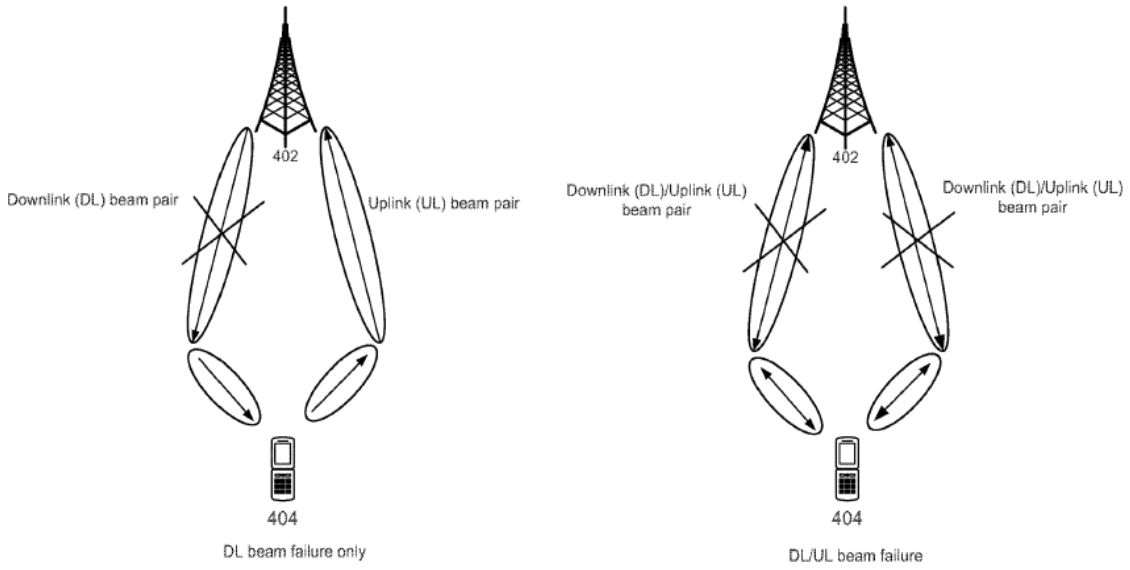


Xia, FIG. 1 (annotated); *Xia Provisional*, FIG. 1.

One wireless communication method described in *Xia* is "a method for beam failure recovery in user equipment." *Xia*, [0005]; *Xia Provisional*, [0004]. *Xia*'s method includes, among other things, "detecting a beam failure event between the user equipment and a base station; sending a first beam failure recovery request (BFRQ) to the base station upon detection of the beam failure event; and searching for a beam failure recovery response (BFRP) within a first response window," and "sending a second BFRQ to the base station for a same beam failure event; and indicating to the base station that the first and second BFRQs correspond to the same beam failure event." *Xia*, [0005]; *Xia Provisional*, [0004], [0007]. This method in a UE for wireless communication is described in more detail below.

b. [1a]: "receiving a target radio signal;"

Xia discloses that the UE receives a target radio signal, which it calls a "reference signal (beam failure detection RS)," from the base station. *Xia*, [0076]-[0078]; *Xia Provisional*, [0062]; Bims, ¶81. As shown in FIGS. 4A and 4B below, *Xia* discloses that "the base station 402 and user equipment 404 communicate via DL [downlink] beam pairs and UL [uplink] beam pairs." *Xia*, [0057]; *Xia Provisional*, [0044]. FIG. 4A illustrates a case in which "the DL beam pair fails," and FIG. 4B illustrates a case in which "the DL/UL beam pair fails." *Xia*, [0057]; *Xia Provisional*, [0044].



Xia, FIGS. 4A (left) and 4B (right); *Xia Provisional*, FIGS. 4A, 4B.

According to *Xia*, "[t]o detect a beam failure, the UE (e.g., UE 404) monitors a **reference signal (beam failure detection RS)** to assess whether a

beam failure trigger condition has been met." *Xia*, [0076]; *Xia Provisional*, [0062]. The beam failure detection RS includes "a periodic **CSI-RS [channel state information-reference signal]** for beam management" or "the periodic CSI-RS and **SS [synchronization signal]-blocks** within the serving cell when the SS-block is used to detect beam failure." *Xia*, [0076]-[0077]; *Xia Provisional*, [0062]. A POSITA would understand that *Xia* receives the beam failure detection RS because the UE detects the beam failure and report[s] detection of the beam failure. Bims, ¶82; *Xia*, [0077]-[0078]; *Xia Provisional*, [0062].

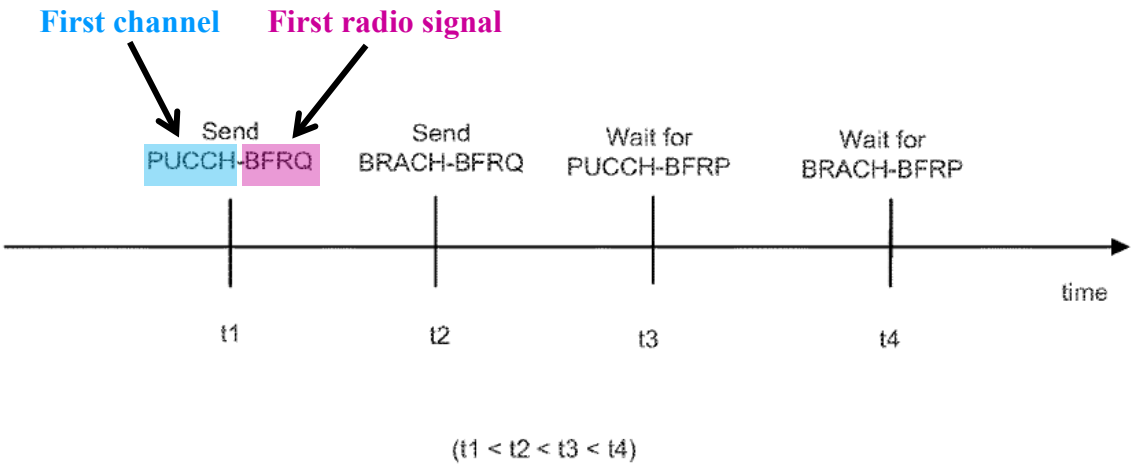
The '113 patent specification states that the claimed "target radio signal" can be a "**reference signal**" such as "a **Channel State Information Reference Signal (CSI-RS)** used for conducting a channel quality measurement of a physical layer control channel," or a "**Synchronization Signal (SS)** used for conducting a channel quality measurement of a physical layer control channel." '113 patent, 2:23-36. Thus, *Xia*'s reference signal (beam failure detection RS), such as the periodic CSI-RS or the SS-block, constitutes the claimed "target reference signal." Bims, ¶83.

c. [1b]: "transmitting a first radio signal on a first channel;"

Xia discloses that, after the UE detects the beam failure, a beam failure recovery request (BFRQ) transmission is performed. *Xia*, [0078]; *Xia Provisional*,

[0062]. According to *Xia*, in some cases, more than one BFRQ (e.g., PUCCH-BFRQ, PRACH-BFRQ) is transmitted by the UE for a single beam failure (BFR) event. *Xia*, [0091]; *Xia Provisional*, [0070]-[0072]. And since more than one BFRQ may be transmitted by the UE, different channels (e.g., PUCCH and PRACH) may be used to send the BFRQ (and receive the BFRP). *Xia*, [0091]; *Xia Provisional*, [0070]-[0072].

For example, as shown in annotated FIG. 6B below, the UE transmits a first Beam Failure Recovery Request (BFRQ) ("**first radio signal**") to the base station on a Physical Uplink Control Channel (PUCCH) ("**first channel**") (PUCCH-BFRQ). *Xia*, [0093], [0097]; *Xia Provisional*, [0073]-[0074], [0084], FIG. 6.



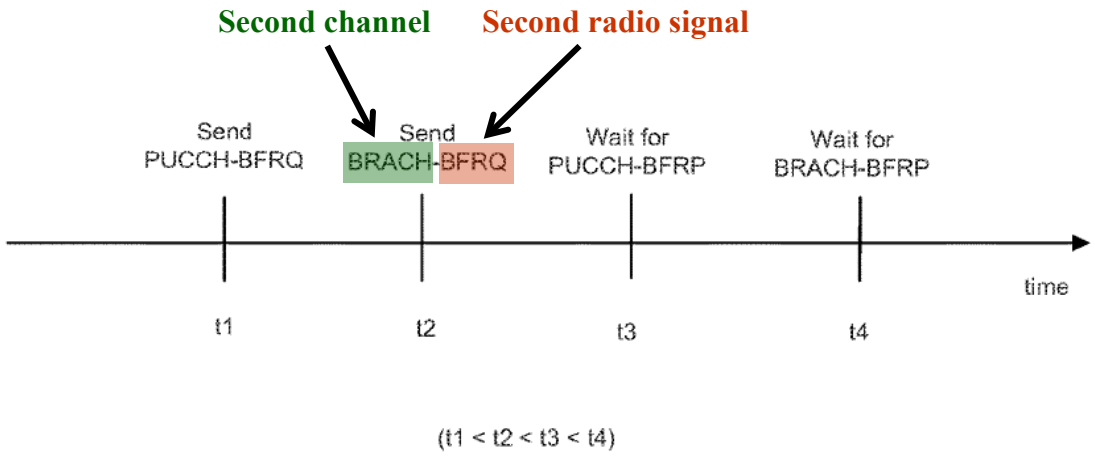
Xia, FIG. 6B (annotated); *Xia Provisional*, FIG. 6.

The '113 patent specification states that the claimed "first radio signal" can be a "beam recovery request[]." '113 patent, 3:41-42, *see also* 13:66-67. The '113 patent also states that "the first channel" can be "a PUCCH." '113 patent, 8:57.

Accordingly, *Xia*'s first BFRQ constitutes the claimed "first radio signal," and *Xia*'s PUCCH constitutes the claimed "first channel." Bims, ¶¶84-86.

d. [1c]: "transmitting a second radio signal on a second channel; and"

After the PUCCH-BFRQ is sent, *Xia* discloses that the UE transmits a second Beam Failure Recovery Request (BFRQ) ("**second radio signal**") to the base station on a Physical Random Access Channel (PRACH) ("**second channel**") (PRACH-BFRQ), as shown in annotated FIG. 6B below. Bims, ¶87.



Xia, FIG. 6B[5] (annotated); *Xia Provisional*, FIG. 6.

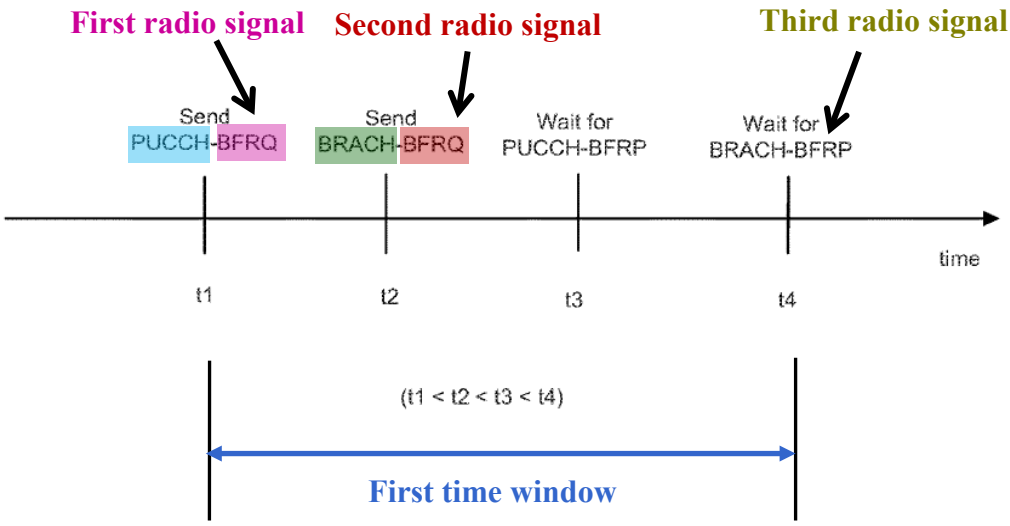
[5] "BRACH-BFRQ" in FIG. 6B corresponds to the term "PRACH-BFRQ" used throughout the specification when referring to the second beam recovery request on the physical random access channel. Bims, 37, n.2.

Specifically, *Xia* explains that, after a PUCCH-BFRQ is sent at t1, and before a PUCCH-BFRP arrives at the UE from the base station, the UE has a PRACH-BFRQ OPPORTUNITY and sends a second BFRQ using a PRACH-BFRQ. *Xia*, [0093], [0102]; *Xia Provisional*, [0065], [0084], FIG. 6.

The '113 patent specification states that the claimed "second radio signal" can be a "beam recovery request[]." '113 patent, 13:66-67. The '113 patent also states that "the second channel" can be "a physical layer random access channel." '113 patent, 8:18-19. Therefore, *Xia*'s second BFRQ constitutes the claimed "second radio signal," and *Xia*'s PRACH constitutes the claimed "second channel." Bims, ¶¶88-89.

e. [1d]: "monitoring a third radio signal in a first time window;"

After sending the first and second BFRQs, *Xia*'s UE waits for (i.e., monitors) a beam failure recovery response (BFRP) ("**third radio signal**") in a first time window, as shown in annotated FIG. 6B below. *Xia*, [0102], [0084]; *Xia Provisional*, [0083]-[0085], FIG. 6; Bims, ¶90.



Xia, FIG. 6B (annotated); *Xia Provisional*, FIG. 6.

As shown above, *Xia*'s UE waits for the BFRP (i.e., PRACH-BFRP) from the base station for a time window from t1 to t4 ("**first time window**"). That is because, a single BFRP is sent in response to two BFRQs. *Xia*, [0102]; *Xia Provisional*, [0083]-[0085]. Specifically, the UE sends two BFRQs, a PUCCH-BFRQ at time t1 and a PRACH-BFRQ at time t2, and the UE waits for a single BFRP from the base station, a PUCCH-BFRP at time t3 or a PRACH-BFRP at t4. *Xia*, [0102]; *Xia Provisional*, [0083]-[0085].

The '113 patent specification states that the "third radio signal" can be "a response to the second radio signal," or "a response to the first radio signal and the second radio signal." '113 patent, 10:47-49, 10:63-64. Thus, *Xia*'s BFRP constitutes the claimed "third radio signal." Bims, ¶92.

Moreover, as shown above in FIG. 6B, *Xia* waits for the single BFRP from the starting position in time (t1) and the ending position in time (t4). *Xia*, [0102]; *Xia Provisional*, [0083]-[0085]. *Xia*'s UE thus monitors the single BFRP in a time window between t1 and t4, i.e., a "first time window," as claimed. Bims, ¶¶93-95; *see also* Ex. 1006, 1-4; Ex. 1021, 1; Rodermund, ¶¶51-55.

f. [1e]: "wherein a measurement for the target radio signal obtains a target measurement value, the target measurement value, when higher than a target threshold is used for triggering the transmission of the first radio signal and the second radio signal;"

Xia alone (**Ground 1**), or alternatively, *Xia* in combination with *Jover* (**Ground 2**), renders obvious this limitation. Bims, ¶96.

Ground 1: *Xia* discloses that, "[t]o detect a beam failure, the UE (e.g., UE 404) monitors a reference signal (beam failure detection RS) to assess whether a beam failure **trigger condition** has been met." *Xia*, [0076]; *Xia Provisional*, [0062]. That is, *Xia* uses an indicator of beam failure ("target measurement value") for triggering the transmission of the first and second BFRQs ("the first radio signal and the second radio signal"). Bims, ¶97.

A POSITA would have understood at the time of the earliest claimed priority date that there were many well-known indicators of beam failure, including, e.g., signal-to-noise ratio (SNR), signal-to-interference-plus-noise ratio (SINR), bit error rate (BER), and/or block error rate (BLER). Bims, ¶98. A POSITA would

have also understood that beam failure (i.e., lower beam signal strength) may be indicated by lower SNR and SINR values or higher BER and BLER values. *Id*. Thus, it would have been obvious to compare these well-known indicators of beam failure to a target threshold to determine whether beam failure has occurred. *Id*. For example, a POSITA would have found it obvious to have used SNR or SINR as the target measurement value such that the triggering condition would be met when the target measurement value is ***lower*** than a target threshold. *Id*. And, a POSITA likewise would have found it obvious to have used BER or BLER as the target measurement value such that the triggering condition would be met when the target measurement value is ***higher*** than a target threshold. *Id*.

Further, a POSITA would have known that, generally, as values for SNR and SINR increase, values for BER and BLER decrease, and *vice versa*. Bims, ¶99; Ex. 1005 (*Jover)*, [0039] (disclosing that "a communication impairment may comprise a decreased signal-to-noise ratio (SNR), decreased signal-to-interference-and-noise (SINR) ratio, decreased received signal strength indication (RSSI) and/or an increased bit-error rate (BER) detected at the endpoint device."); Ex. 1013 (*Vembu*), 7:25-28 (disclosing that "[t]he BER rising above a threshold is analogous to the SNR 208 falling below threshold 204."); *see also* Ex. 1009 (*Pandey*), 466 (disclosing that "[a]s the SNR increase, BER constantly decreases."); Ex. 1015 (showing *Pandey* was published in 2013). And a POSITA would also have known

how to readily convert between values of SNR and SINR and values of BER and BLER. Bims, ¶99. Indeed, it was very common at the time of the earliest claimed priority date to use these values interchangeably. *Id*.

Thus, implementing a target measurement value (e.g., SNR or SINR) that is lower than a target threshold as a triggering condition, or a target measurement value (e.g., BER or BLER) that is higher than a target threshold as a triggering condition would have been a matter of simple design choice between the two known alternatives (lower and higher), which was well within the skill of a POSITA. Bims, ¶100; *See KSR Int'l Co. v. Teleflex Inc*., 550 U.S. 398, 416-417, 421 (2007); *Uber Techs., Inc. v. X One, Inc*., 957 F.3d 1334, 1338-41 (Fed. Cir. 2020).

The '113 patent acknowledges that these two sets of values may be used interchangeably for triggering the transmission of the first and second radio signals. Bims, ¶101. Specifically, the '113 patent discloses the use of either (1) a target measurement value such as a bit error rate (BER) or a block error rate (BLER) is higher than a target threshold (*see* '113 patent, 5:9-14); or (2) a target measurement value such as a signal-to-noise ratio (SNR) or signal-to-interference-plus-noise ratio (SINR) is less than a target threshold (*see id*., 4:62-5:3). The '113 patent does not describe any advantages or disadvantages of using one triggering condition versus another. Bims, ¶101. And because both conditions lead to the

same result—transmission of the first and second radio signals—a POSITA would have found it obvious to readily change between these well-known measurement values. *Id*.

A POSITA would have had a reasonable expectation of success as it would have been straightforward for a POSITA to modify *Xia*'s triggering condition to use a target measurement value (such as BER), such that the beam failure recovery would be triggered if the value was ***higher*** than a target threshold. Bims, ¶102. For example, evaluating BER was well known and widely used long before August 11, 2017. *See, e.g.*, Ex. 1009 (*Pandey*), 463-466; Ex. 1013 (*Vembu*), 7:25-32, 7:37-47. Thus, it would have been straightforward to modify *Xia*'s triggering condition (BER). Bims, ¶102. Further, modifying *Xia*'s trigger condition would have yielded predictable results—namely, accurately and reliably determining beam failures. *Id*.

Therefore, *Xia* renders obvious this limitation [1e]. Bims, ¶103.

Ground 2: To the extent that Patent Owner argues that *Xia* does not render obvious this limitation [1e], the combination of *Xia* and *Jover* renders it obvious. Bims, ¶104. Specifically, *Jover* explicitly discloses detecting a communication impairment (e.g., a connection failure) between an endpoint device (e.g., a UE) and a base station by detecting "a **threshold** drop in the SNR or SINR (e.g., a 20 percent drop as compared to a preceding time period)[,] an **increase in the BER** (e.g., when the **BER increases beyond one percent**), and so forth." *Jover*, [0040].

Jover further discloses that when "one or more of such threshold conditions are met, the wireless channel sensing engine 320 may signal to the beam-forming engine 310 to begin the beam sweeping procedure." *Jover*, [0040]. Thus, *Jover* specifically discloses using a target measurement value (BER) that is higher than a target threshold (1%) as a triggering condition, as claimed. Bims, ¶104.

It would have been obvious to implement *Jover*'s teachings in *Xia*'s method such that *Xia*'s beam failure triggering condition uses BER as the target measurement value, as taught by *Jover*. *Jover*, [0039]-[0040]; Bims, ¶105. Both *Xia* and *Jover* involve wireless communications between a UE and a base station. *Xia*, FIGS. 1, 8A-8B; *Xia Provisional*, FIGS. 1, 8A-8B; *Jover*, FIG. 1. And both references are also specifically directed to detecting a communication failure between the UE and the base station. *Xia*, [0091]-[0093], [0097]-[0103], [0105]-[0106], FIGS. 6B, 7A-7B; *Xia Provisional*, [0084]-[0085], FIG. 6B; *Jover*, [0039]-[0040], FIG. 3. And *Jover* provides using a target measurement value (BER) that is higher than a target threshold (1%) as a triggering condition. *Jover*, [0039]-[0040].

A POSITA would have been motivated to adopt *Jover*'s specific triggering condition in *Xia*'s method. Bims, ¶106. *Xia* already discloses that the transmission of the first and second BFRQs to the base station in response to the detection of a communication failure. *Id*. And *Jover* simply provides further details about a specific way to implement *Xia*'s teachings regarding the detection of the

communication failure, and a POSITA would have been motivated and found it obvious to look to *Jover* to understand and implement its additional teachings. *Id*. A POSITA thus would have been motivated to implement *Jover*'s triggering condition in *Xia*'s method to improve the accuracy and reliability of the beam failure determination. *Id*. For example, the addition of a triggering condition based on BER would have provided additional measurements to ensure a beam failure detection is appropriate. *Id*. (citing Ex. 1013 (*Vembu*), 7:25-32 ("[i]f the BER rises above threshold by more than a predetermined amount, the system is no longer operating nominally."), 7:37-47 ("receiver 112 is described as determining whether or not the system is at, above, or below threshold and whether the system is operating nominally," and "send[ing] a command to transmitter 108 (108 b, 108 a) instructing transmitter 108 change modes when appropriate."). Further, a POSITA would have been motivated to implement *Jover*'s triggering condition, because of the known benefits of evaluating BER or BLER. Bims, ¶106 (citing Ex. 1009 (*Pandey*), 463 (disclosing that "[t]he most meaningful criterion for evaluation of performance of communication systems is the bit error rate (BER)"); Ex. 1013 (*Vembu*), 7:25-32, 7:37-47). Thus, a POSITA would have been motivated to implement *Jover*'s triggering condition in *Xia*'s method because of the advantages provided by *Jover*'s triggering condition. Bims, ¶106. *See KSR*, 550 U.S. at 417 ("[I]f a technique has been used to improve one device, and a person of ordinary

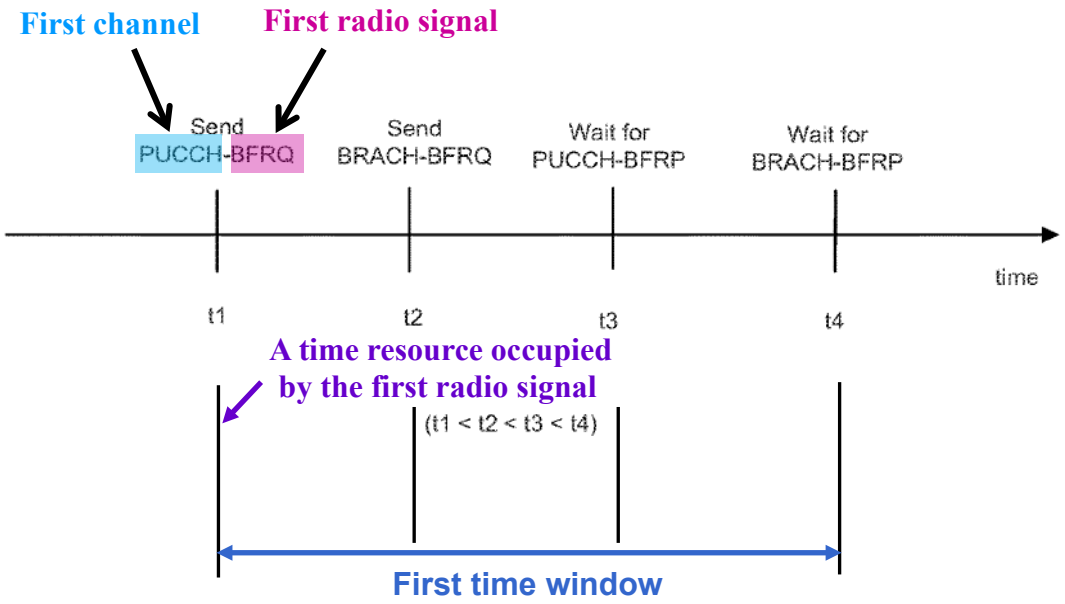
skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill."), 421; *Uber*, 957 F.3d at 1338-41.

A POSITA would have had a reasonable expectation of success as it would have been straightforward for a POSITA to implement *Jover*'s triggering condition in *Xia*'s method. Bims, ¶107. As mentioned above, *Xia* and *Jover* include similar components that perform similar functions, and both *Xia* and *Jover* detect communication failures between the UE and the base station. Also, evaluating BER was well known and widely used long before August 11, 2017. *See, e.g.*, Ex. 1009 (*Pandey*), 463-466; Ex. 1013 (*Vembu*), 7:25-32, 7:37-47; Bims, ¶107. Thus, it would have been straightforward to add *Jover*'s triggering condition (BER) to *Xia*'s existing method. *Id*. Further, implementing *Jover*'s teachings in *Xia* would have yielded predictable results—namely, accurately and reliably determining beam failures. *Id*.; *see KSR*, 550 U.S. at 421; *Uber*, 957 F.3d at 1338-41.

Thus, *Xia* alone (**Ground 1**) or *Xia* in combination with *Jover* (**Ground 2**) renders obvious the claim [1e]. Bims, ¶108.

g. [1f]: "a time resource occupied by the first radio signal is used for determining the start time of the first time window;"

As shown in annotated FIG. 6B below, *Xia* discloses that a time resource occupied by the first radio signal (t1 in FIG. 6B) is used for determining the start time of the first time window. Bims, ¶109.



Xia, FIG. 6B (annotated); *Xia Provisional*, FIG. 6.

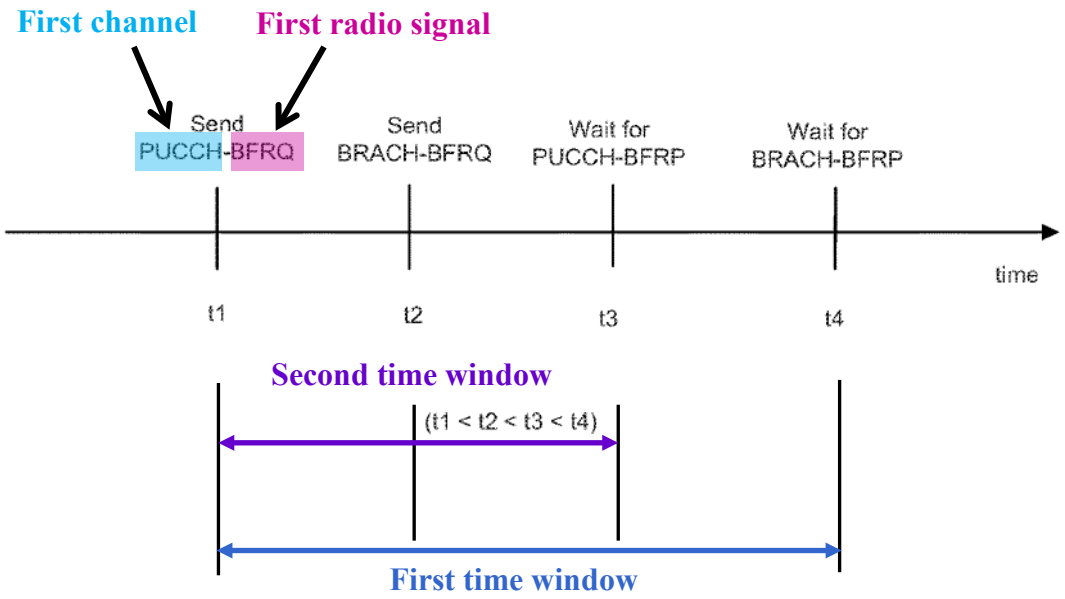
A POSITA would have understood "a time resource occupied by the first radio signal" to include a start time of the first radio signal. Bims, ¶110. This is consistent with the '113 patent, which explains that time domain resources of the first and second signals can be start times of the time windows. '113 patent, 23:13-22 ("a time domain resource occupied by the first radio signal is the start time of

the second time window," and "a time domain resource occupied by the second radio signal is the start time of the third time window"); Bims, ¶110.

Further, as discussed above for claim [1d], *Xia* discloses monitoring for a BFRP in the "first time window," and that monitoring begins in response to the first BFRQ. Thus, as shown above in FIG. 6B, a time resource occupied by the first BFRQ, for example, the starting time of the first BFRQ, is used for determining the start time of the first time window. Bims, ¶111.

h. [1g]: "a time domain resource occupied by the first radio signal is used for determining a second time window,"

As shown in annotated FIG. 6B below, *Xia* discloses that a time domain resource occupied by the first radio signal (beginning at t1 in FIG. 6B) is used for determining a second time window (a time window between t1 and t3). Bims, ¶112.



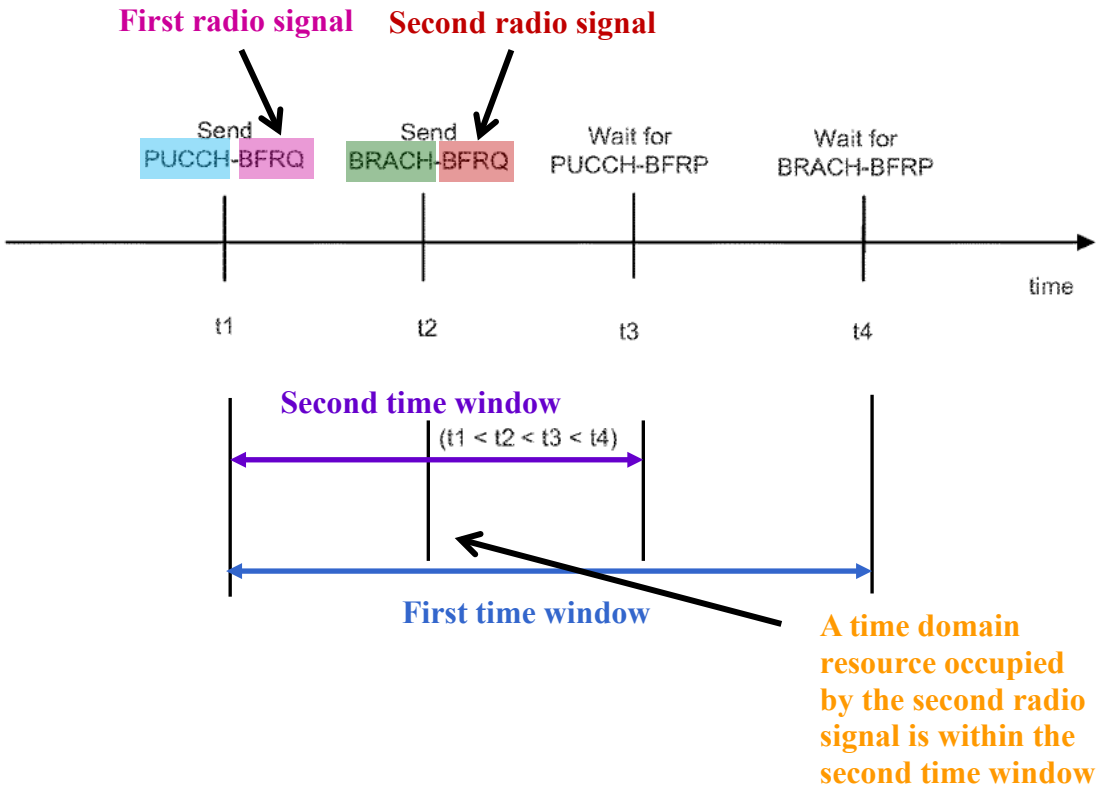
Xia, FIG. 6B (annotated); *Xia Provisional*, FIG. 6.

As discussed above for claim [1d], *Xia*'s UE waits for a single BFRP from the base station, a PUCCH-BFRP at time t3 or a PRACH-BFRP at t4. *Xia*, [0102]; *Xia Provisional*, [0083]-[0085]. Thus, the time window for waiting on the PUCCH-BFRP between t1 and t3 represents a "second time window" that begins in response to the first PUCCH-BFRQ. Bims, ¶113.

The '113 patent specification states that "the start time of the second time window and the start time of the first time window are the same." '113 patent, 9:23-25. Just like the '113 patent, in *Xia*, the start time of the second time window and the start time of the first time window are the same. Bims, ¶114.

i. [1h]: "a time domain resource occupied by the second radio signal is within the second time window, and the second time window is within the first time window;"

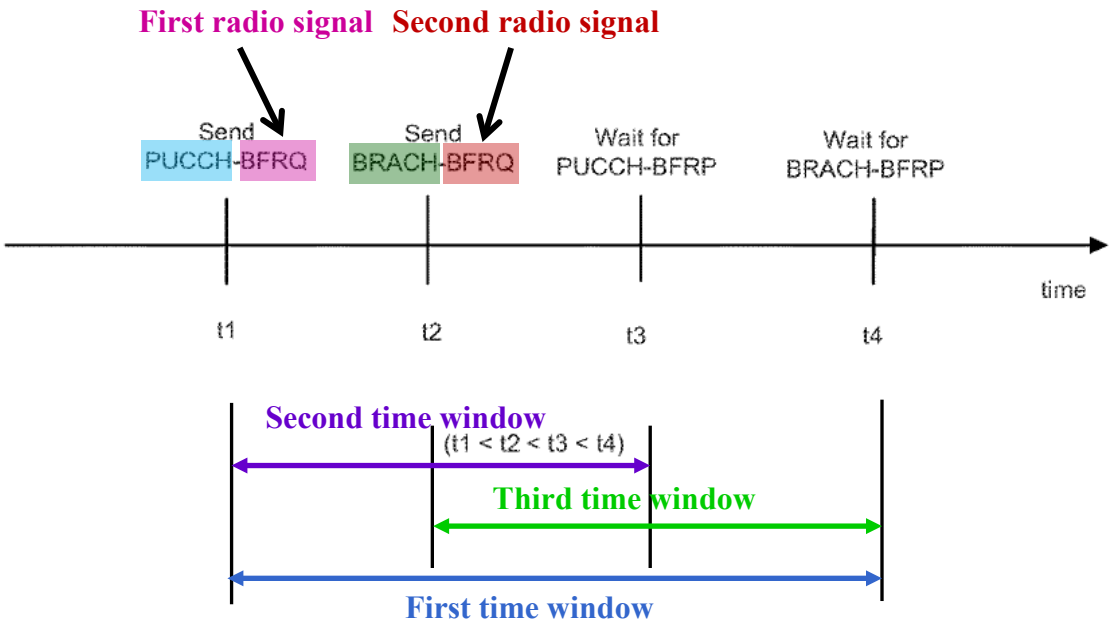
As shown in annotated FIG. 6B below, *Xia* discloses that a time domain resource occupied by the second radio signal (beginning at t2 in FIG. 6B) is within the second time window. Bims, ¶115. Also, as shown in the figure, the second time window (the time window between t1 and t3) is within the first time window (the time window between t1 and t4). *Id*.



Xia, FIG. 6B (annotated); *Xia Provisional*, FIG. 6.

j. [1i]: "a time domain resource occupied by the second radio signal is used for determining a third time window, and the end time of the third time window is the end time of the first time window; and"

As shown in annotated FIG. 6B below, *Xia* discloses that a time domain resource occupied by the second radio signal (beginning at t2 in FIG. 6B) is used for determining a third time window (the time window between t2 and t4). Bims, ¶116. Also, as shown in the figure below, the end time of the third time window (t4) is the end time of the first time window (t4). *Id*.



Xia, FIG. 6B (annotated); *Xia Provisional*, FIG. 6.

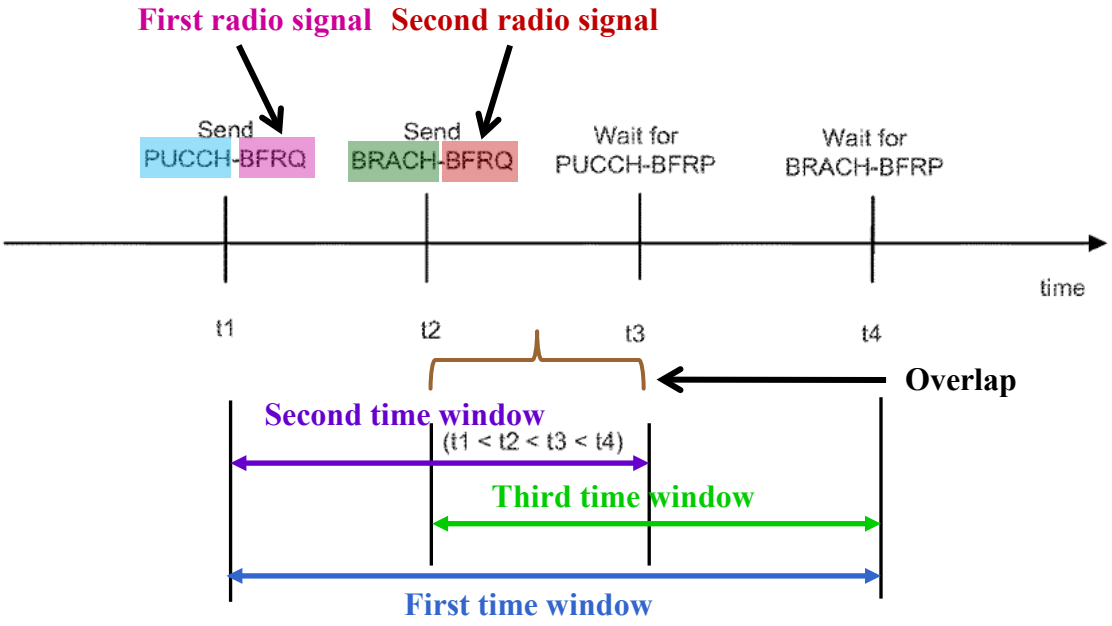
As discussed above for claim [1d], *Xia*'s UE waits for a single BFRP from the base station, a PUCCH-BFRP at time t3 or a PRACH-BFRP at t4. *Xia*, [0102]; *Xia Provisional*, [0083]-[0085]. Thus, the time window for waiting on the

PRACH-BFRP between t2 and t4 represents a "second time window" that begins in response to the first PRACH-BFRQ. Bims, ¶117.

Further, as discussed above for claims [1f], [1g], and [1i], the "first time window" and the "third time window" are time windows for monitoring for a BFRP. Thus, as illustrated in FIG. 6B, both the "first time window" and the "third time window" end when the BFRP is received. Bims, ¶118.

k. [1j]: "the second time window and the third time window have overlapped time domain resource(s)."

As shown in annotated FIG. 6B below, *Xia* discloses that the second time window (the time window between t1 and t3) and the third time window (the time window between t2 and t4) have overlapped time domain resource(s). Bims, ¶119.



Xia, FIG. 6B (annotated); *Xia Provisional*, FIG. 6.

As shown in FIG. 6B, *Xia* discloses that the PUCCH-BFRQ is sent followed by the PRACH-BFRQ. *Xia*, [0093]; *Xia Provisional*, [0083]-[0085]. In particular, after a PUCCH-BFRQ is sent at t1, and before a PUCCH-BFRP arrives at the UE from the base station, the UE has a PRACH-BFRQ OPPORTUNITY and sends a second BFRQ using a PRACH-BFRQ. *Xia*, [0093]; *Xia Provisional*, [0083]-[0085]. Thus, because the second BFRQ is sent at t2 before the UE stops waiting for PUCCH-BFRP at t3, there must be an overlap between the second time window (which ends at t3) and the third time window (which starts at t2). Bims, ¶120.

Therefore, *Xia* alone (**Ground 1**) or *Xia* in combination with *Jover* (**Ground 2**) renders obvious claim 1. Bims, ¶121.

2. Claim 2

a. [2a]: "The method according to claim 1, wherein at least one signal of the following set of signals: {the first radio signal, the second radio signal} is used for determining a multi-antenna related transmitting of the third radio signal; or,"

For the reasons discussed above, *Xia* alone or in combination with *Jover* renders obvious claim 1. *Xia* further discloses a multiple-input multiple-output (MIMO) system with multiple antenna arrangements in the base station and the user equipment. *Xia*, [0073]-[0074], FIG. 4C; *Xia Provisional*, [0002], [0030], [0037]-[0038], [0044]-[0048], [0055]-[0061], [0064]; Bims, ¶122.

As discussed for claim [1d], *Xia*'s base station transmits a single BFRP ("third radio signal") in response to the two BFRQs ("first radio signal" and "second radio signal"). *Xia* also discloses that each BFRQ sent from the UE includes information about a new candidate beam determined by the UE. Bims, ¶123. For example, *Xia* discloses that, after the UE detects the beam failure, a beam failure recovery request (BFRQ) transmission is performed. *Xia*, [0078]; *Xia Provisional*, [0062]. The BFRQ contains information that includes at least the following: "explicit/implicit information that identifies the UE 404 and new gNB TX beam information, and explicit/implicit information that identifies the UE 404 and whether a new candidate beam exists." *Xia*, [0078]; *Xia Provisional*, [0062].

Xia further discloses that "[i]n order for the base station 402 to send a BFRQ response, the user equipment 404 first determines which candidate beam(s) may be used by the base station 402 to send a response." *Xia*, [0067]; *Xia Provisional*, [0055]. Specifically, *Xia* explains that, in determining the candidate beam, the UE uses the spatial quasi co-located (SQCL'ed) information between the DL and the UL beams. For example, "[t]o determine the **candidate beam**, the user equipment 402 uses the **spatial quasi co-located (SQCL'ed)** information between the base station 402 transmission (DL) and receive (UL) beams. *Xia*, [0068]; *Xia Provisional*, [0055]-[0061].

Xia further discloses that the UE monitors the base station's response to the BFRQ (i.e., BFRP) that is SQCL'ed with the identified candidate beam. Bims, ¶¶124-125. For example, *Xia* discloses that the UE will monitor the base station DL beam(s) SQCL'ed with the base station UL receive beam for BFRQ reception. *Xia*, [0069]; *Xia Provisional*, [0055]-[0061]. Specifically, the UE monitors the PDCCH region of a DL beam with the assumption that the corresponding PDCCH demodulation reference signal (DMRS) is SQCL'ed with the RS of the identified candidate beam(s) by the UE. *Xia*, [0069]; *Xia Provisional*, [0055]-[0061]. That is, *Xia*'s base station uses a UL BFRQ signal received from the UE for determining a multi-antenna related transmitting of the response to the two BFRQs (i.e., BFRP). Bims, ¶125.

Thus, in *Xia*, the multi-antenna related transmitting of the single BFRP from the base station is determined based on the UL BFRQs from the UE. Bims, ¶126. And, because there are two BFRQs (PUCCH-BFRQ and PRACH-BFRQ), determining the multi-antenna related transmitting of the single BFRP can be based on one of the three scenarios: (1) based on PUCCH-BFRQ; (2) based on PRACH-BFRQ; or (3) based on both PUCCH-BFRQ and PRACH-BFRQ. Bims, ¶126; *Xia*, [0101]-[0103]; *Xia Provisional*, [0083]-[0085]. In other words, in *Xia*, at least one signal of the following set of signals {PUCCH-BFRQ, PRACH-BFRQ} is used for

determining a multi-antenna related transmitting of the single BFRP. Bims, ¶¶126-128; *see also* Ex. 1006, 1; Ex. 1021, 1, 4-5, FIG. 4.

b. [2b]: "the first radio signal and the second radio signal together are used for determining the multi-antenna related transmitting of the third radio signal."

Claim 2 includes an "or" between claim [2a] and [2b], so only one of the two limitations must be taught to satisfy claim 2. *Brown v. 3M*, 265 F.3d 1349, 1351 (Fed. Cir. 2001).

Nonetheless, *Xia* discloses this limitation in scenario (3) discussed above, where the multi-antenna related transmitting of the single BFRP is based on both PUCCH-BFRQ and PRACH-BFRQ. Bims, ¶¶129-130; *see also* Ex. 1006, 1; *see also* Ex. 1021, 1, 4-5.

3. Claim 3

a. "The method according to claim 1, wherein the first channel is a first type of physical layer channel, the second channel is a second type of physical layer channel, and the first type of physical layer channel and the second type of physical layer channel are two different types of physical layer channels."

As discussed above, *Xia* alone or in combination with *Jover* renders obvious claim 1. As discussed for claim [1b] and claim [1c], *Xia*'s PUCCH (Physical Uplink Control Channel) constitutes the claimed "first channel," and *Xia*'s PRACH (Physical Random Access Channel) constitutes the claimed "second channel." The

PUCCH and the PRACH are both physical layer channels, and the PUCCH is a different type of physical layer channel than the PRACH, as claimed. Bims, ¶131.

4. Claim 4

a. "The method according to claim 1, wherein the first channel is a physical layer control channel."

As discussed above, *Xia* alone or in combination with *Jover* renders obvious claim 1. As discussed for claim [1b], *Xia*'s PUCCH (Physical Uplink Control Channel) constitutes the claimed "first channel." The PUCCH is a physical layer control channel, as claimed. Bims, ¶132.

5. Claim 5

a. [5a]: "The method according to claim 1, wherein the first radio signal is used for determining a first antenna port group, and the first antenna port group is spatially related to an antenna port group used for transmitting the third radio signal, the being spatially related refers to being Quasi Co-Located ("QCL"); or,"

As discussed above, *Xia* alone or in combination with *Jover* renders obvious claim 1. As discussed for claim 2, *Xia* further discloses that the base station's BFRP beam is quasi co-located with the UE's BFRQ beam. For example, *Xia* discloses that the UE will monitor the base station DL beam(s) **SQCL'ed** with the base station UL receive beam for BFRQ reception. *Xia*, [0069]; *Xia Provisional*, [0055].

A POSITA would have understood that, because the base station's BFRP beam is quasi co-located with the UE's BFRQ beam, the antenna port(s) for the BFRP are SQCL'ed with the antenna port(s) for the BFRQ. Bims, ¶134. For example, *R1-1700771* defines "QCL" as follows: "[t]wo antenna ports are said to be quasi co-located if properties of the channel over which a symbol on one antenna port is conveyed can be inferred from the channel over which a symbol on the other antenna port is conveyed." Ex. 1022, 1; Rodermund, ¶¶56-59; *see also*, *Xia*, [0068] ("[t]wo antenna ports may be said to be SQCL'ed if large-scale properties of a radio channel over which a symbol on one antenna port is conveyed can be inferred from a radio channel over which a symbol on the other antenna port is conveyed."

As also discussed with respect to claim 2, in *Xia*, determining the multi-antenna related transmitting of the single BFRP can be based on one of the three scenarios: (1) based on PUCCH-BFRQ; (2) based on PRACH-BFRQ; or (3) based on both PUCCH-BFRQ and PRACH-BFRQ. Bims, ¶135. In scenarios (1) and (3), the PUCCH-BFRQ ("first radio signal") is used for determining the antenna port group used for transmitting the single BFRP ("third radio signal"). Bims, ¶135. And thus, in scenarios (1) and (3), the antenna port group for the first radio signal is quasi co-located with the antenna port group used for transmitting the third radio signal. *Id*.

b. [5b]: "the first time window is divided into a second time interval and a third time interval, the second time interval is before the third time interval, the third time interval is behind a time domain resource occupied by the second radio signal, the first radio signal is used for determining a second antenna port group, in the second time interval, the second antenna port group is spatially QCL with an antenna port group used for transmitting the third radio signal in the second time interval, the second radio signal is used for determining a third antenna port group; in the third time interval, the third antenna port group is spatially QCL with an antenna port group used for transmitting the third radio signal in the third time interval."

Claim 5 includes an "or" between claim [5a] and [5b], so the above-discussed teachings of claim [5a] are sufficient to satisfy claim 5. *Brown v. 3M*, 265 F.3d at 1351.

6. Independent Claim 6

a. [6pre]: "A method in a base station device for wireless communication, comprising:"

As discussed for claim [1pre], *Xia* discloses a wireless communication system in which a UE communicates with a base station. *Xia*, [0037], [0041]; *Xia Provisional*, [0025]-[0031]. In particular, *Xia* discloses "a method for beam failure recovery in user equipment." *Xia*, [0005]; *Xia Provisional*, [0004], [0007]. And, although this wireless communication method is primarily described from the perspective of the UE, *Xia* also discloses the corresponding method performed by

the base station because the method involves the UE wirelessly interfacing with the base station. Bims, ¶137. For example, a radio signal that is transmitted from the UE is also received by the base station for wireless communication. *Id.* Likewise, a radio signal that is received by the UE is also transmitted by the base station for wireless communication. *Id.*

b. [6a]: "transmitting a target radio signal;"

As discussed for claim [1a], *Xia*'s UE receives a reference signal (beam failure detection RS) ("target radio signal") from the base station. *Xia*, [0076]-[0078]; *Xia Provisional*, [0062]. Thus, *Xia* discloses the base station "transmitting a target radio signal." Bims, ¶138.

c. [6b]: "receiving a first radio signal on a first channel;"

As discussed for claim [1b], *Xia*'s UE transmits a first BFRQ ("first radio signal") to the base station via a PUCCH ("first channel") (PUCCH-BFRQ). *Xia*, [0093], [0097]; *Xia Provisional*, [0083]-[0085]. *Xia* further discloses that, in response to the BFRQ, the base station transmits a BFRP. *Xia*, [0102]-[0103], FIG. 6B; *Xia Provisional*, [0083]-[0085], FIG. 6B. A POSITA would have understood that, because the base station sends a response, it must have received the request. Bims, ¶139. Thus, *Xia* discloses the base station "receiving a first radio signal on a first channel." *Id.*

d. [6c]: "receiving a second radio signal on a second channel; and"

As discussed for claim [1c], *Xia*'s UE transmits a second BFRQ ("second radio signal") to the base station via a PRACH ("first channel") (PRACH-BFRQ). *Xia*, [0093], [0102]; *Xia Provisional*, [0073]-[0074], [0083]-[0085]. *Xia* further discloses that, in response to the BFRQ, the base station transmits a BFRP. *Xia*, [0102]-[0103], FIG. 6B; *Xia Provisional*, [0083]-[0085], FIG. 6B. A POSITA would have understood that, because the base station sends a response, it must have received the request. Bims, ¶140. Thus, *Xia* discloses the base station "receiving a second radio signal on a second channel." *Id.*

e. [6d]: "transmitting a third radio signal in a first time window;"

As discussed for claim [1d], *Xia*'s UE waits for (i.e., monitors) a beam failure recovery response (BFRP) ("third radio signal") from the base station in a time window from t1 to t4 ("first time window"). *Xia*, [0102]-[0103]; *Xia Provisional*, [0083]-[0085]. *Xia* further discloses that the base station transmits a BFRP in the first time window. *Xia*, [0102]-[0103], FIG. 6B; *Xia Provisional*, [0083]-[0085], FIG. 6B. Thus, *Xia* discloses the base station "transmitting a third radio signal in a first time window." Bims, ¶141.

f. [6e]: "wherein a measurement for the target radio signal obtains a target measurement value, the target measurement value, when higher than a target threshold, is used for triggering the transmission of the first radio signal and the second radio signal;"

As discussed for claim [1e], *Xia* alone (**Ground 1**) or *Xia* in combination with *Jover* (**Ground 2**) render this limitation obvious. Bims, ¶142.

g. [6f]: "a time resource occupied by the first radio signal is used for determining the start time of the first time window;"

As discussed for claim [1f], *Xia* discloses this limitation. Bims, ¶143.

h. [6g]: "a time domain resource occupied by the first radio signal is used for determining a second time window,"

As discussed for claim [1g], *Xia* discloses this limitation. Bims, ¶144.

i. [6h]: "a time domain resource occupied by the second radio signal is within the second time window, and the second time window is within the first time window;"

As discussed for claim [1h], *Xia* discloses this limitation. Bims, ¶145.

j. [6i]: "a time domain resource occupied by the second radio signal is used for determining a third time window, and the end time of the third time window is the end time of the first time window; and"

As discussed for claim [1i], *Xia* discloses this limitation. Bims, ¶146.

k. [6j]: "the second time window and the third time window have overlapped time domain resource(s)."

As discussed for claim [1j], *Xia* discloses this limitation. Bims, ¶147.

Therefore, *Xia* alone (**Ground 1**) or *Xia* in combination with *Jover* (**Ground 2**) render obvious claim 6. Bims, ¶148.

7. Claim 7

a. Claim [7a]: "The method according to claim 6, wherein at least one signal of the following set of signals: {the first radio signal, the second radio signal} is used for determining a multi-antenna related transmitting of the third radio signal; or,"

For the reasons discussed above, *Xia* alone or in combination with *Jover* renders obvious claim 6. As discussed for claim [2a], *Xia* discloses this additional limitation of claim [7a]. Bims, ¶149.

b. Claim [7b]: "the first radio signal and the second radio signal together are used for determining the multi-antenna related transmitting of the third radio signal."

As discussed for claim [2b], *Xia* discloses this additional limitation of claim [7b]. Bims, ¶150.

8. Claim 8

a. "The method according to claim 6, wherein the first channel is a first type of physical layer channel, the second channel is a second type of physical layer channel, and the first type of physical layer channel and the second type of physical layer channel are two different types of physical layer channels."

For the reasons discussed above, *Xia* alone or in combination with *Jover* renders obvious claim 6. As discussed for claim 3, *Xia* discloses this additional limitation of claim 8. Bims, ¶151.

9. Claim 9

a. "The method according to claim 6, wherein the first channel is a physical layer control channel."

For the reasons discussed above, *Xia* alone or in combination with *Jover* renders obvious claim 6. As discussed for claim 4, *Xia* discloses this additional limitation of claim 9. Bims, ¶152.

10. Claim 10

a. [10a]: "The method according to claim 6, wherein the first radio signal is used for determining a first antenna port group, and the first antenna port group is spatially related to an antenna port group used for transmitting the third radio signal, the being spatially related refers to being Quasi Co-Located ("QCL"); or,"

For the reasons discussed above, *Xia* alone or in combination with *Jover* renders obvious claim 6. As discussed for claim [5a], *Xia* discloses this additional limitation of claim [10a]. Bims, ¶153.

b. 10[b]: "the first time window is divided into a second time interval and a third time interval, the second time interval is before the third time interval, the third time interval is behind a time domain resource occupied by the second radio signal, the first radio signal is used for determining a second antenna port group, in the second time interval, the second antenna port group is spatially QCL with an antenna port group used for transmitting the third radio signal in the second time interval, the second radio signal is used for determining a third antenna port group; in the third time interval, the third antenna port group is spatially QCL with an antenna port group used for transmitting the third radio signal in the third time interval."

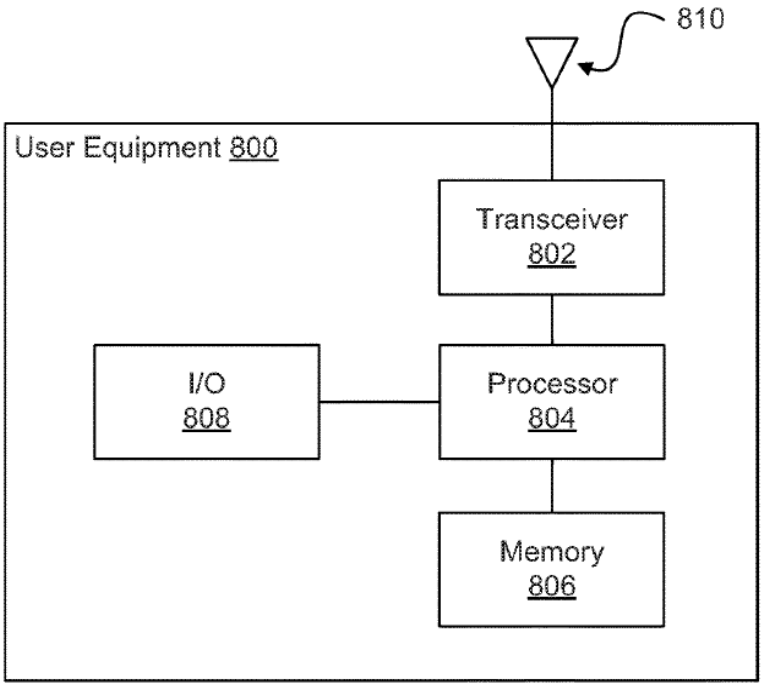
Claim 10 includes an "or" between claim [10a] and [10b], so nothing beyond the above-discussed teachings is required to satisfy claim 10. *Brown v. 3M*, 265 F.3d at 1351.

11. Independent Claim 11

a. [11pre]: "A UE for wireless communication, comprising:"

As discussed for claim [1pre], *Xia* discloses a wireless communication system in which a UE communicates with a base station. *Xia*, [0037], [0041]; *Xia Provisional*, [0025]-[0031]. *Xia* also discloses "a method for beam failure recovery in user equipment." *Xia*, [0005]; *Xia Provisional*, [0004], [0007].

Xia further discloses the structure of the UE and how it is used for wireless communication. Bims, ¶¶155-160. As shown in FIG. 8A below, the UE 800 includes at least one processor 804, at least one transceiver 802, one or more input/output devices 808, at least one antenna 810, and at least one memory 806. *See Xia*, [0107]-[0110]; *Xia Provisional*, [0086]-[0089].



Xia, FIG. 8A; *Xia Provisional*, FIG. 8A.

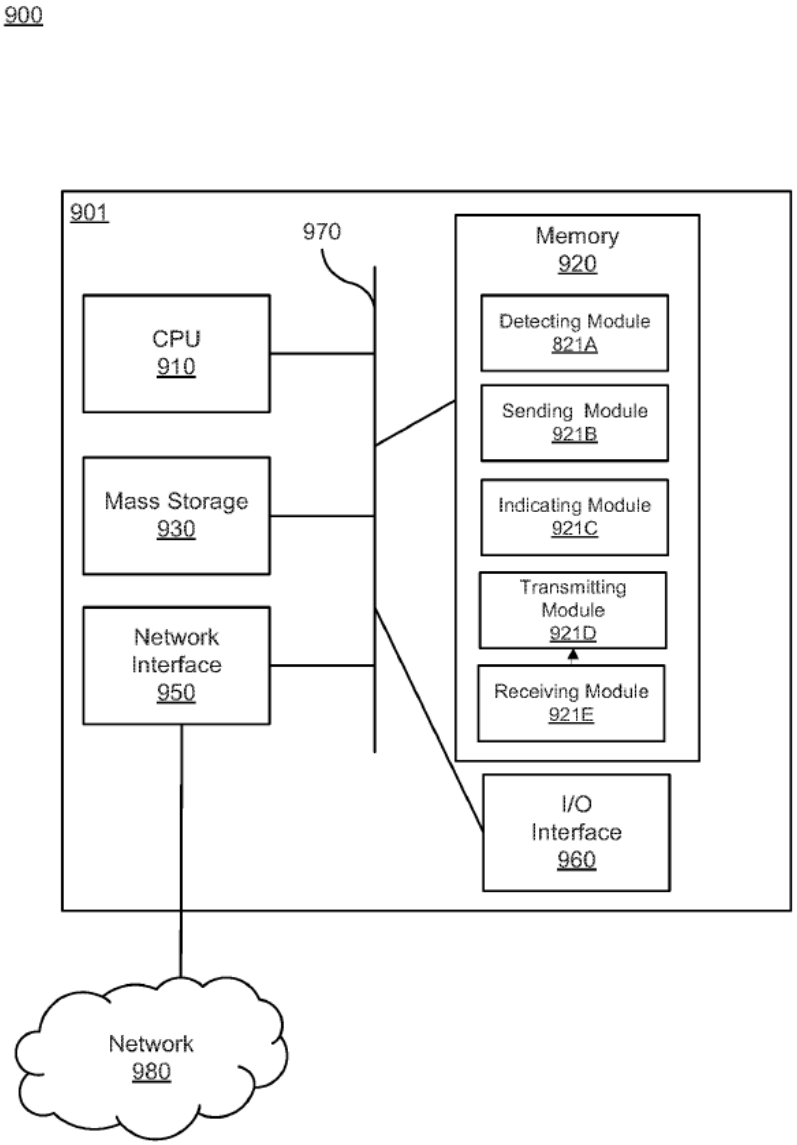
Xia discloses that "one or multiple transceivers 802 could be used in the UE 800," and that "a transceiver 802 may also be implemented using at least one transmitter and at least one separate receiver." *Xia*, [0108]; *Xia Provisional*, [0087]. Thus, *Xia*'s UE has one or more transmitters and one or more receivers. Bims, ¶157. *Xia* further discloses that "[e]ach transceiver 802 may include any suitable structure for generating signals for wireless transmission and/or processing signals received wirelessly." *Xia*, [0108]; *Xia Provisional*, [0087].

In addition, each transceiver 802 (or separate transmitter/receiver) is "configured to demodulate data or other content received by the at least one antenna 810," and "[e]ach antenna 810 includes any suitable structure for transmitting and/or receiving wireless signals." *Xia*, [0108]; *Xia Provisional*, [0087]. Thus, a POSITA would have understood that each antenna in *Xia*'s UE may be associated with a transmitter and a receiver. Bims, ¶158.

Moreover, as discussed for claim [2a], *Xia* discloses a MIMO system, including multiple antenna arrangements in the user equipment. *Xia*, [0073]-[0074], FIG. 4C; *Xia Provisional*, [0030], [0064], [0037]-[0038], [0044]-[0048], [0055]-[0061], [0002]. Thus, a POSITA would have understood that, with a multiple antenna arrangement, *Xia*'s UE would have multiple transmitters and multiple receivers for transmitting and receiving wireless signals. Bims, ¶159.

Furthermore, a POSITA would have understood that, in MIMO systems, each antenna arrangement (and therefore each transmitter and receiver associated with that antenna) is capable of transmitting and receiving any given wireless signal that goes into or out of the UE. Bims, ¶159.

As shown in FIG. 9 below, *Xia* also discloses a network device 900 that may be used to facilitate communications between the UE and the base station. *Xia*, [0113]-[0114]; *Xia Provisional*, [0092]-[0092]; Bims, ¶160. A POSITA would have understood that this network device 900 can be part of the UE. *Id*. The network device 900 includes a memory 920 that includes "a detecting module 921A detecting a beam failure event between the user equipment and a base station," "a receiving module 921E receiving a beam," "a sending module 921B sending a first beam failure recovery request (BFRQ) to the base station upon detection of the beam failure, wherein the first BFRQ is sent using one of a physical uplink channel (PUCCH) and a beam failure random access channel (PRACH)," and "a transmitting module 921D transmitting a beam." *Xia*, [0113]-[0114]; *Xia Provisional*, [0092]-[0092].



Xia, FIG. 9; *Xia Provisional*, FIG. 9.

b. [11a]: "a first receiver module, to receive a target radio signal;"

As discussed for claim [1a], *Xia*'s UE receives a target radio signal. *Xia* discloses the claimed "first receiver module" in at least two ways. Bims, ¶161.

First, as discussed for claim [11pre], *Xia*'s UE can have multiple receivers for receiving wireless signals. Thus, a POSITA would understand that a first one of the receivers in *Xia*'s UE constitutes "a first receiver module, to receive a target radio signal." Bims, ¶162.

Second, as also discussed for claim [11pre], *Xia*'s UE can also include a detecting module 921A detecting a beam failure event between the user equipment and a base station. As discussed for claim [1a], the '113 patent explains that the "target radio signal" can be a reference signal for detecting a beam failure. Thus, a POSITA would understand that *Xia*'s detecting module 921A constitutes "a first receiver module, to receive a target radio signal." Bims, ¶163.

c. [11b]: "a second transmitter module, to transmit a first radio signal on a first channel;"

As discussed for claim [1b], *Xia*'s UE transmits a first radio signal on a first channel. *Xia* discloses the claimed "second transmitter module" in at least two ways. Bims, ¶164.

First, as discussed for claim [11pre], *Xia*'s UE can have multiple transmitters for transmitting wireless signals. Thus, a POSITA would understand that a first one of the transmitters in *Xia*'s UE constitutes "a second transmitter module, to transmit a first radio signal on a first channel." Bims, ¶165.

Second, as also discussed for claim [11pre], *Xia*'s UE can also include a sending module 921B for sending a first beam failure recovery request to the base station. As discussed for claim [1b], the '113 patent explains that the "first radio signal" can be a beam recovery request. Thus, a POSITA would understand that *Xia*'s sending module 921B constitutes "a second transmitter module, to transmit a first radio signal on a first channel." Bims, ¶166.

d. [11c]: "a third transmitter module, to transmit a second radio signal on a second channel; and"

As discussed for claim [1c], *Xia*'s UE transmits a second radio signal on a second channel. *Xia* discloses the claimed "third transmitter module" in at least two ways. Bims, ¶167.

First, as discussed for claim [11pre], *Xia*'s UE can have multiple transmitters for transmitting wireless signals, and in MIMO systems, multiple antenna arrangements (and therefore multiple transmitters associated with those arrangements) transmit wireless signals that go out of the UE. Bims, ¶168. Thus, a POSITA would understand that a second one of the transmitters in *Xia*'s UE constitutes "a third transmitter module, to transmit a second radio signal on a second channel." *Id.*

Second, as also discussed for claim [11pre], *Xia*'s UE can also include a transmitting module 921D for transmitting a beam. Thus, a POSITA would

understand that *Xia*'s transmitting module 921D constitutes "a third transmitter module, to transmit a second radio signal on a second channel." Bims, ¶169.

e. [11d]: "a fourth receiver module, to monitor a third radio signal in a first time window;"

As discussed for claim [1d], *Xia*'s UE monitors a third radio signal in a first time window. *Xia* discloses the claimed "fourth receiver module" in at least two ways. Bims, ¶170.

First, as discussed for claim [11pre], *Xia*'s UE can have multiple receivers for receiving wireless signals, and in MIMO systems, multiple antenna arrangements (and therefore multiple receivers) receive wireless signals that go into the UE. Bims, ¶171. Thus, a POSITA would understand that a second one of the receivers in *Xia*'s UE constitutes "a fourth receiver module, to monitor a third radio signal in a first time window." *Id.*

Second, as also discussed for claim [11pre], *Xia*'s UE can also include a receiving module 921E for receiving a beam. Thus, a POSITA would understand that *Xia*'s receiving module 921E constitutes "a fourth receiver module, to monitor a third radio signal in a first time window." Bims, ¶172.

f. [11e]: "wherein a measurement for the target radio signal obtains a target measurement value, the target measurement value, when higher than a target threshold, is used for triggering the transmission of the first radio signal and the second radio signal;"

As discussed for claim [1e], *Xia* alone (**Ground 1**) or *Xia* in combination with *Jover* (**Ground 2**) render this limitation obvious. Bims, ¶173.

g. [11f]: "a time resource occupied by the first radio signal is used for determining the start time of the first time window;"

As discussed for claim [1f], *Xia* discloses this limitation. Bims, ¶174.

h. [11g]: "a time domain resource occupied by the first radio signal is used for determining a second time window,"

As discussed for claim [1g], *Xia* discloses this limitation. Bims, ¶175.

i. [11h]: "a time domain resource occupied by the second radio signal is within the second time window, and the second time window is within the first time window;"

As discussed for claim [1h], *Xia* discloses this limitation. Bims, ¶176.

j. [11i]: "a time domain resource occupied by the second radio signal is used for determining a third time window, and the end time of the third time window is the end time of the first time window; and"

As discussed for claim [1i], *Xia* discloses this limitation. Bims, ¶177.

k. [11j]: "the second time window and the third time window have overlapped time domain resource(s)."

As discussed for claim [1j], *Xia* discloses this limitation. Bims, ¶178.

Therefore, *Xia* alone (**Ground 1**) or *Xia* in combination with *Jover* (**Ground 2**) render obvious claim 11. Bims, ¶179.

12. Claim 12

a. [12a]: "The UE according to claim 11, wherein at least one signal of the following set of signals: {the first radio signal, the second radio signal} is used for determining a multi-antenna related transmitting of the third radio signal; or,"

For the reasons discussed above, *Xia* alone or in combination with *Jover* renders obvious claim 11. As discussed for claim [2a], *Xia* discloses this additional limitation of claim [12a]. Bims, ¶180.

b. [12b]: "the first radio signal and the second radio signal together are used for determining the multi-antenna related transmitting of the third radio signal."

As discussed for claim [2b], *Xia* discloses this additional limitation of claim [12b]. Bims, ¶181.

13. Claim 13

a. "The UE according to claim 11, wherein the first channel is a first type of physical layer channel, the second channel is a second type of physical layer channel, and the first type of physical layer channel and the second type of physical layer channel are two different types of physical layer channels."

For the reasons discussed above, *Xia* alone or in combination with *Jover* renders obvious claim 11. As discussed for claim 3, *Xia* discloses this additional limitation of claim 13. Bims, ¶182.

14. Claim 14

a. "The UE according to claim 11, wherein the first channel is a physical layer control channel."

For the reasons discussed above, *Xia* alone or in combination with *Jover* renders obvious claim 11. As discussed for claim 4, *Xia* discloses this additional limitation of claim 14. Bims, ¶183.

15. Claim 15

a. [15a]: "The UE according to claim 11, wherein the first radio signal is used for determining a first antenna port group, and the first antenna port group is spatially related to an antenna port group used for transmitting the third radio signal, the being spatially related refers to being Quasi Co-Located ("QCL"); or,"

For the reasons discussed above, *Xia* alone or in combination with *Jover* renders obvious claim 11. As discussed for claim [5a], *Xia* discloses this additional limitation of claim [15a]. Bims, ¶185.

b. [15b]: "the first time window is divided into a second time interval and a third time interval, the second time interval is before the third time interval, the third time interval is behind a time domain resource occupied by the second radio signal, the first radio signal is used for determining a second antenna port group, in the second time interval, the second antenna port group is spatially QCL with an antenna port group used for transmitting the third radio signal in the second time interval, the second radio signal is used for determining a third antenna port group; in the third time interval, the third antenna port group is spatially QCL with an antenna port group used for transmitting the third radio signal in the third time interval."

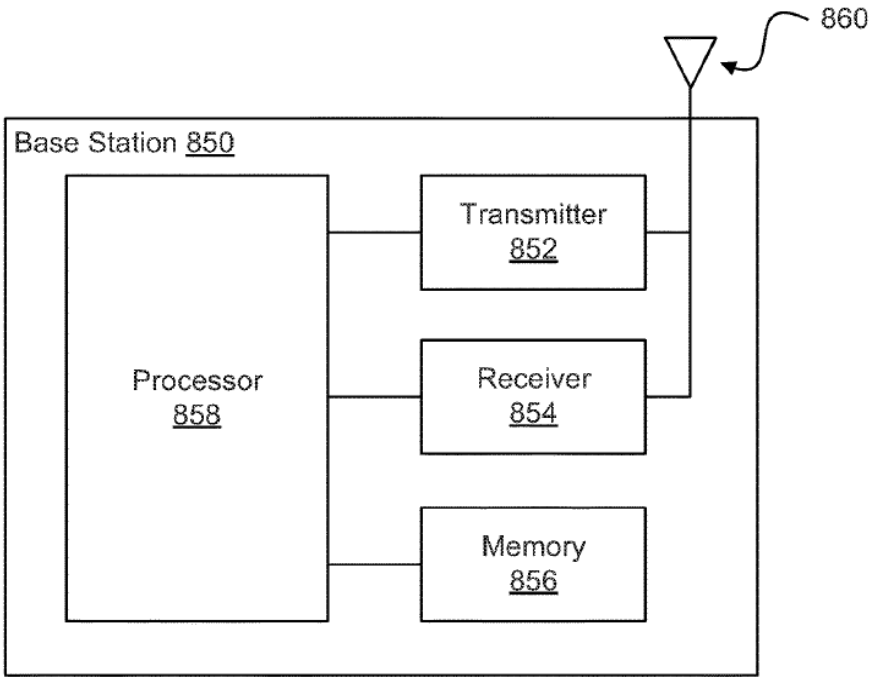
Claim 15 includes an "or" between claim [15a] and [15b], so nothing beyond the above-discussed teachings is required to satisfy claim 15. *Brown v. 3M*, 265 F.3d at 1351.

16. Independent Claim 16

a. [16pre]: "A base station device for wireless communication, comprising:"

As discussed for claim [6pre], *Xia* discloses a wireless communication system in which a UE communicates with a base station. *Xia*, [0037], [0041]; *Xia Provisional*, [0025]-[0026]. *Xia* also discloses "a method for beam failure recovery in user equipment." *Xia*, [0005], [0014]; *Xia Provisional*, [0004], [0007].

Xia further discloses the structure of the base station and how it is used for wireless communication. Bims, ¶¶186-189. As shown in FIG. 8B below, the base station 850 includes at least one processor 858, at least one transmitter 852, at least one receiver 854, one or more antennas 860, and at least one memory 856. *See Xia*, [0111]-[0112]; *Xia Provisional*, [0090]-[0091], FIG. 8B.



Xia, FIG. 8B; *Xia Provisional*, FIG. 8B.

Xia discloses that "[e]ach transmitter 852 includes any suitable structure for generating signals for wireless transmission to one or more UEs or other devices," while "[e]ach receiver 854 includes any suitable structure for processing signals received wirelessly from one or more UEs or other devices." *Xia*, [0112]; *Xia Provisional*, [0091]. *Xia* further discloses that "[e]ach antenna 860 includes any suitable structure for transmitting and/or receiving wireless signals," and that "one or more antennas 860 could be coupled to the transmitter(s) 852, and one or more separate antennas 860 could be coupled to the receiver(s) 854." *Xia*, [0112]; *Xia Provisional*, [0091]. Thus, a POSITA would have understood that each antenna in *Xia*'s base station may be associated with a transmitter and a receiver. Bims, ¶188.

Moreover, as discussed for claim [2a], *Xia* discloses a MIMO system, including multiple antenna arrangements in the base station. *Xia*, [0073]-[0074], FIG. 4C; *Xia Provisional*, [0030], [0064], [0037]-[0038], [0044]-[0048], [0055]-[0061], [0002]; Bims, ¶189. Thus, a POSITA would have understood that, with a multiple antenna arrangement, *Xia*'s base station would have multiple transmitters and multiple receivers for transmitting and receiving wireless signals. *Id.* Furthermore, a POSITA would have understood that, in MIMO systems, each antenna arrangement (and therefore each transmitter and receiver associated with

that antenna) is capable of transmitting and receiving any given wireless signal that goes into or out of the base station. *Id.*

b. [16a]: "a first transmitter module, to transmit a target radio signal;"

As discussed for claim [6a], *Xia*'s base station transmits a target radio signal. Further, as discussed for claim [16pre], *Xia*'s base station can have multiple transmitters for transmitting wireless signals. Thus, a POSITA would understand that a first one of the transmitters in *Xia*'s base station constitutes "a first transmitter module, to transmit a target radio signal." Bims, ¶190.

c. [16b]: "a second receiver module, to receive a first radio signal on a first channel;"

As discussed for claim [6b], *Xia*'s base station receives a first radio signal on a first channel. Further, as discussed for claim [16pre], *Xia*'s base station can have multiple receivers for receiving wireless signals. Thus, a POSITA would understand that a first one of the receivers in *Xia*'s base station constitutes "a second receiver module, to receive a first radio signal on a first channel." Bims, ¶191.

d. [16c]: "a third receiver module, to receive a second radio signal on a second channel; and"

As discussed for claim [6c], *Xia*'s base station receives a second radio signal on a second channel. Further, as discussed for claim [16pre], *Xia*'s base station can

have multiple receivers for receiving wireless signals, and in MIMO systems, multiple antenna arrangements (and therefore multiple receivers) receive wireless signals that go into the base station. Bims, ¶192. Thus, a POSITA would understand that a second one of the receivers in *Xia*'s base station constitutes "a third receiver module, to receive a second radio signal on a second channel." *Id.*

e. [16d]: "a fourth transmitter module, to transmit a third radio signal in a first time window;"

As discussed for claim [6d], *Xia*'s base station transmits a third radio signal in a first time window. Further, as discussed for claim [16pre], *Xia*'s base station can have multiple transmitters for transmitting wireless signals, and in MIMO systems, multiple antenna arrangements (and therefore multiple transmitters) transmit wireless signals that go out of the base station. Bims, ¶193. Thus, a POSITA would understand that a second one of the transmitters in *Xia*'s UE constitutes "a fourth transmitter module, to transmit a third radio signal in a first time window." *Id.*

f. [16e]: "wherein a measurement for the target radio signal obtains a target measurement value, the target measurement value, when higher than a target threshold, is used for triggering the transmission of the first radio signal and the second radio signal;"

As discussed for claim [6e], *Xia* alone (**Ground 1**) or *Xia* in combination with *Jover* (**Ground 2**) render this limitation obvious. Bims, ¶194.

g. [16f]: "a time resource occupied by the first radio signal is used for determining the start time of the first time window;"

As discussed for claim [6f], *Xia* discloses this limitation. Bims, ¶195.

h. [16g]: "a time domain resource occupied by the first radio signal is used for determining a second time window,"

As discussed for claim [6g], *Xia* discloses this limitation. Bims, ¶196.

i. [16h]: "a time domain resource occupied by the second radio signal is within the second time window, and the second time window is within the first time window;"

As discussed for claim [6h], *Xia* discloses this limitation. Bims, ¶197.

j. [16i]: "a time domain resource occupied by the second radio signal is used for determining a third time window, and the end time of the third time window is the end time of the first time window; and"

As discussed for claim [6i], *Xia* discloses this limitation. Bims, ¶198.

k. [16j]: "the second time window and the third time window have overlapped time domain resource(s)."

As discussed for claim [6j], *Xia* discloses this limitation. Bims, ¶199.

Therefore, *Xia* alone (**Ground 1**) or *Xia* in combination with *Jover* (**Ground 2**) render obvious claim 16. Bims, ¶200.

17. Claim 17

a. [17a]: "The base station device according to claim 16, wherein at least one signal of the following set of signals: {the first radio signal, the second radio signal} is used for determining a multi-antenna related transmitting of the third radio signal; or,"

For the reasons discussed above, *Xia* alone or in combination with *Jover* renders obvious claim 16. As discussed for claim [2a], *Xia* discloses this additional limitation of claim [17a]. Bims, ¶201.

b. 17[b]: "the first radio signal and the second radio signal together are used for determining the multi-antenna related transmitting of the third radio signal."

As discussed for claim [2b], *Xia* discloses this additional limitation of claim [17b]. Bims, ¶202.

18. Claim 18

a. "The base station device according to claim 16, wherein the first channel is a first type of physical layer channel, the second channel is a second type of physical layer channel, and the first type of physical layer channel and the second type of physical layer channel are two different types of physical layer channels."

For the reasons discussed above, *Xia* alone or in combination with *Jover* renders obvious claim 16. As discussed for claim 3, *Xia* discloses this additional limitation of claim 18. Bims, ¶203.

19. Claim 19

a. "The base station device according to claim 16, wherein the first channel is a physical layer control channel."

For the reasons discussed above, *Xia* alone or in combination with *Jover* renders obvious claim 16. As discussed for claim 4, *Xia* discloses this additional limitation of claim 19. Bims, ¶204.

20. Claim 20

a. [20a]: "The base station device according to claim 16, wherein the first radio signal is used for determining a first antenna port group, and the first antenna port group is spatially related to an antenna port group used for transmitting the third radio signal, the being spatially related refers to being QCL; or,"

For the reasons discussed above, *Xia* alone or in combination with *Jover* renders obvious claim 16. As discussed for claim [5a], *Xia* discloses this additional limitation of claim [20a]. Bims, ¶205.

b. [20b]: "the first time window is divided into a second time interval and a third time interval, the second time interval is before the third time interval, the third time interval is behind a time domain resource occupied by the second radio signal, the first radio signal is used for determining a second antenna port group, in the second time interval, the second antenna port group is spatially QCL with an antenna port group used for transmitting the third radio signal in the second time interval, the second radio signal is used for determining a third antenna port group; in the third time interval, the third antenna port group is spatially QCL with an antenna port group used for transmitting the third radio signal in the third time interval."

Claim 20 includes an "or" between claim [20a] and [20b], so nothing beyond the above-discussed teachings is required to satisfy claim 20. *Brown v. 3M*, 265 F.3d at 1351.

VII. DISCRETIONARY DENIAL IS NOT WARRANTED

A. Denial of Institution Is Not Warranted Under *Fintiv*

Fintiv and the Office's interim guidelines dated June 21, 2022 ("Interim Procedures") require institution. Factor 6 requires institution because Petitioner presents a compelling unpatentability challenge; Factors 3 and 4 favor institution; and Factors 1, 2, and 5 are, at worst, neutral.

Factor 3 favors institution because Petitioner acted diligently and almost no parallel investment has occurred. Patent Owner served infringement contentions only last month. Ex. 1020. Fact discovery opened only this month, and will not

close until February 2024, with expert discovery closing March 2024. Ex. 1019, 3. The parties will not begin claim construction until August 2023 and the hearing will not take place until December 2023. *Id.*

Factor 4 favors institution because this petition challenges claims 6-10 and 16-20, which are not involved in the litigation. Moreover, Petitioner has not served invalidity contentions, so no overlap currently exists. Petitioner reserves the right to submit a stipulation after serving invalidity contentions.

Regarding Factors 1, 2, and 5, Patent Owner filed its Complaint against Petitioner on June 1, 2022. Ex. 1017. No stay has been requested, trial is currently scheduled for June 24, 2024, and the median time-to-trial in the Eastern District of Texas is 24.5 months, so trial is projected to occur, at the earliest, in June or July 2024. Ex. 1019, 1; Ex. 1018, 35. A FWD is anticipated in August 2024, about one month after trial ends. In these circumstances, Factors 1, 2, and 5 are at worst neutral. *Protect Animals with Satellites v. OnPoint Sys.*, IPR2021-01483, Paper 11 at 12-13, 17 (Mar. 4, 2022). Indeed, the Board has instituted with far more time between trial and FWD. *See NetNut v. Bright Data*, IPR2021-01492, Paper 12 at 9-16 (Mar. 21, 2022) (instituting IPR without stipulation and co-pending trial date six months before FWD); *Protect Animals*, IPR2021-01483, Paper 11 at 18 (instituting IPR without stipulation and co-pending trial date one month before FWD); Interim Procedures, 8.

Denial of institution is not warranted under *Fintiv*

B. Denial of Institution Is Not Warranted Under 35 U.S.C. § 325(d)

No other proceedings involving the '113 patent are currently pending or have been brought before the Patent Office. Additionally, neither of the asserted prior art references (*Xia* or *Jover*) were before the Examiner during prosecution. Thus, the same or substantially the same prior art or arguments have not been previously presented to the Patent Office and denial of institution is not warranted under § 325(d).

VIII. MANDATORY NOTICES

A. Real Party-in-Interest

The real parties-in-interest are Samsung Electronics Co., Ltd., and Samsung Electronics America, Inc.

B. Related Matters

This petition is related to IPR2023-00602.

Apex asserted the '113 patent in the following litigations: *Apex Beam Technologies LLC v. Samsung Electronics Co., Ltd. et al.*, Case No. 2:22-cv-00188-JRG (E.D. Tex.); *Apex Beam Technologies LLC v. ZTE Corporation*, Case No. 2:22-cv-00031-JRG-RSP (E.D. Tex.); *Apex Beam Technologies LLC v. OnePlus Technology (Shenzhen) Co., Ltd.*, Case No. 2:22-cv-00032-JRG (E.D.

Tex.); and *Apex Beam Technologies LLC v. TCT Mobile International Limited et al.*, Case No. 2:21-cv-00438-JRG (E.D. Tex.).

The '113 patent is related to CN 109391300 B and CN 112600653 A.

C. Lead and Backup Counsel, and Service Information

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Please address all correspondence to counsel at the addresses above. Petitioner consents to electronic service by email at the above email addresses.

IX. GROUNDS FOR STANDING

Petitioner certifies that the '113 patent is available for IPR and that Petitioner is not barred or estopped from requesting IPR challenging the patent claims on the grounds identified herein.

X. CONCLUSION

For the reasons set forth above, Petitioner has established a reasonable likelihood that the challenged claims are unpatentable. Petitioner requests institution of *inter partes* review and cancellation of each challenged claim. The Office may charge any required fees to Deposit Account No. 06-0916.

Dated: February 28, 2023

By: /Joshua L. Goldberg/
Joshua L. Goldberg, Lead Counsel
Reg. No. 59,369

CERTIFICATION OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24, Petitioner certifies that the word count of Petitioner's Petition for *Inter Partes* Review (exclusive of any table of contents, table of authorities, mandatory notices under § 42.8, certificates of service and word count, and list of exhibits or claim listing) as measured by Microsoft Word is 12,919.

Dated: February 28, 2023

By: /Joshua L. Goldberg/
Joshua L. Goldberg, Lead Counsel
Reg. No. 59,369

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e) and 42.105(a), the undersigned certifies that on February 28, 2023, a copy of the foregoing Petition for *Inter Partes* Review, the associated powers of attorney, and Exhibits 1001-1007, 1009-1022 were served by FedEx Priority Overnight on the correspondence address of record indicated in the Patent Office's Patent Center website for U.S. Patent No. 10,568,113:

Jialin Zhong
Zhong Law, LLC
51 JFK Parkway
1st Floor West
Short Hills, NJ 07078

A courtesy copy of the foregoing was also served by FedEx Priority Overnight on the address listed on the same law firm's website (https://zhong-law.com/):

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