IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of:	Xiaobo Zhang	
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Title:	METHOD AND DEVICE IN UE AND BASE STATION USED FOR WIRELESS COMMUNICATION	

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PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT NO. 10,568,113 PURSUANT TO 35 U.S.C. §§ 311–319, 37 C.F.R. § 42

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LIST OF EXHIBITS

APPLE-1001	U.S. Patent No. 10,568,113
APPLE-1002	U.S. Patent No. 10,568,113 File History
APPLE-1003	Declaration of Dr. Robert Akl
APPLE-1004	U.S. Patent Application Publication No. 2019/0053294 to Xia et al. ("Xia")
APPLE-1005	U.S. Patent Application Publication No. 2015/0141026 to Jover ("Jover")
APPLE-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")
APPLE-1007	U.S. Patent No. 10,461,994 to Liu et al. ("Liu")
APPLE-1008	Reserved
APPLE-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 ("Pandey")
APPLE-1010	Screen shot of 3GPP Portal showing the upload time of R1-1710596 on the 3GPP website
APPLE-1011	International Patent Publication No. WO 2017/024516 A1 to Lu et al., published February 16, 2017 ("Lu")
APPLE-1012	U.S. Provisional Application No. 62/543,765 to Xia et al. ("Xia Provisional")

APPLE-1013	U.S. Patent No. 6,185,432 to Vembu ("Vembu")
APPLE-1014	U.S. Provisional Application No. 62,521,170 to Liu et al. ("Liu Provisional")
APPLE-1015	Printout of https://www.atlantis-press.com/proceedings/cac2s-13/6357
APPLE-1016	3GPP Declaration of Friedhelm Rodermund
APPLE-1017	First Amended Complaint, *Apex Beam Tech's LLC. v. Apple Inc.*, 6:24-cv-00223-ADA-DIG (WDTX May 2, 2024)
APPLE-1018	Complaint, Apex Beam Tech's LLC. v. Apple Inc., 6:24-cv-00223-ADA-DIG (WDTX April 29, 2024)
APPLE-1019	Proof of Service, Apex Beam Tech's LLC. v. Apple Inc., 6:24-cv-00223-ADA-DIG (May 14, 2024)
APPLE-1020	Reserved
APPLE-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")
APPLE-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")
APPLE-1023	Reserved
APPLE-1024	Reserved
APPLE-1025	Reserved

APPLE-1026	Reserved
APPLE-1027	Reserved
APPLE-1028	Reserved
APPLE-1029	Reserved
APPLE-1030	Joint Claim Construction and Prehearing Statement, Apex Beam Technologies, LLC v. ZTE Corp., 2:22-cv-00031-JRG-RSP (Lead Case) (E.D. Tex) (Sept. 22, 2023)
APPLE-1031	Reserved
APPLE-1032	Memorandum: Interim Processes for PTAB Workload Management ("Stewart Memorandum")
APPLE-1033	Patent Trial and Appeal Board (PTAB) Boardside Chat Interim processes relating to institution in AIA proceedings (April 24, 2025) *available at* https://www.uspto.gov/sites/default/files/documents/boardside_chat_interim_process_for_aia_institution_decisions_.pdf
APPLE-1034	IPR2023-00602 EX1002 Bims Declaration

LISTING OF CLAIMS

Claim 1	
1pre	A method in a User Equipment (UE) for wireless communication, comprising:
1a	receiving a target radio signal;
1b	transmitting a first radio signal on a first channel;
1c	transmitting a second radio signal on a second channel; and
1d	monitoring a third radio signal in a first time window;
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;
1f	a time resource occupied by the first radio signal is used for determining the start time of the first time window;
1g	a time domain resource occupied by the first radio signal is used for determining a second time window,
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;
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
1j	the second time window and the third time window have overlapped time domain resource(s).
Claim 2	

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,
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 3	
3	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.
Claim 4	
4	The method according to claim 1, wherein the first channel is a physical layer control channel.
Claim 5	
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,
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 6	
6pre	A method in a base station device for wireless communication, comprising:
6a	transmitting a target radio signal;
6b	receiving a first radio signal on a first channel;

6c	receiving a second radio signal on a second channel; and
6d	transmitting a third radio signal in a first time window;
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;
6f	a time resource occupied by the first radio signal is used for determining the start time of the first time window;
6g	a time domain resource occupied by the first radio signal is used for determining a second time window,
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;
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
6j	the second time window and the third time window have overlapped time domain resource(s).
Claim 7	
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,
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.
Claim 8	

8	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.

Claim 9	
9	The method according to claim 6, wherein the first channel is a physical layer control channel.
Claim 10	
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,
10b	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 11	
11pre	A UE for wireless communication, comprising:
11a	a first receiver module, to receive a target radio signal;
11b	a second transmitter module, to transmit a first radio signal on a first channel;
11c	a third transmitter module, to transmit a second radio signal on a second channel; and
11d	a fourth receiver module, to monitor a third radio signal in a first time window;

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;
11f	a time resource occupied by the first radio signal is used for determining the start time of the first time window;
11g	a time domain resource occupied by the first radio signal is used for determining a second time window,
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;
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
11j	the second time window and the third time window have overlapped time domain resource(s).
Claim 12	
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,
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.
Claim 13	
13	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.
Claim 14	

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

Claim 15	
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,
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 16	
16pre	A base station device for wireless communication, comprising:
16a	a first transmitter module, to transmit a target radio signal;
16b	a second receiver module, to receive a first radio signal on a first channel;
16c	a third receiver module, to receive a second radio signal on a second channel; and
16d	a fourth transmitter module, to transmit a third radio signal in a first time window;
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;

16f	a time resource occupied by the first radio signal is used for determining the start time of the first time window;
16g	a time domain resource occupied by the first radio signal is used for determining a second time window,
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;
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
16j	the second time window and the third time window have overlapped time domain resource(s).
Claim 17	
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,
17b	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 18	
18	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.
Claim 19	
19	The base station device according to claim 16, wherein the first channel is a physical layer control channel.

Claim 20	
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,
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.

I. PRELIMINARY STATEMENT

Apple Inc. ("Apple" or "Petitioner") requests *inter partes* review of U.S. Patent No. 10,568,113 (APPLE-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. 2018/0367374 to Liu et al. ("Liu") (APPLE-1007).

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

II. REQUIREMENTS FOR IPR UNDER 37 C.F.R. §42.104

A. Grounds for Standing Under 37 C.F.R. §42.104(a)

Apple Inc. certifies that the '113 Patent is available for IPR. The present petition is being filed within one year of service of a complaint *Apex Beam Technologies LLC v. Apple Inc*, 6-24-cv-00223 (WDTX), filed April 29, 2024. Petitioner is not barred or estopped from requesting this review challenging the Challenged Claims on the below-identified grounds.

B. Challenge Under 37 C.F.R. §42.104(b) and Relief Requested

Petitioner requests an IPR of the Challenged Claims on the grounds set forth in the table shown below, and requests that each of the Challenged Claims be found unpatentable. An explanation of how these claims are unpatentable under the statutory grounds identified below is provided in the form of detailed description and claim charts that follow, indicating where each element can be found in the cited prior art, and the relevance of that prior art. Additional explanation and support for each ground of rejection is set forth in APPLE-1003, the Declaration of Robert Akl ("Expert Declaration"), referenced throughout this Petition.

Ground	'113 Patent Claims	Basis for Rejection
Ground 1	1-20	§103: Liu + Jover

Each prior art reference forming the grounds herein pre-dates the earliest

claimed priority date of the '113 patent, August 11, 2017 ("Critical Date"),[1] which Petitioner does not concede.

Reference	Filing/Priority	Publication	Status
Liu	6/16/2017	12/20/2018	§102(a)(2)
Jover	11/15/2013	5/21/2015	§§102(a)(1)-(a)(2)

APPLE-1007, U.S. Patent Application Publication No. 2018/0367374 to Liu et al., published December 20, 2018, and filed on November 16, 2017 ("Liu"), is prior art to the '113 patent under 35 U.S.C. § 102(a)(2). Liu is entitled to its provisional filing date of June 16, 2017. Support for at least one claim of Liu is shown in the claim chart below. In addition, support for each citation relied upon from Liu is set forth in the sections below.

Claim 1 of Liu	**Support in Liu Provisional (APPLE-1014)**
1. A method for beam failure recovery in user equipment, comprising:	"A method for beam failure recovery in user equipment, comprising:" APPLE-1014, claim 1; *see also* [0001], [0004].
sending a beam failure recovery request (BFRR) to a base station upon detection of a beam failure between the base station and the user equipment; and	"sending a beam failure recovery request (BFRR) to the base station upon detection of a beam failure between the base station and the user equipment;" APPLE-1014, claim 1; *see also* [0074], [0078]-[0079], FIGS. 5B, 6A.

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

monitoring one or more candidate beams in which to receive a BFRR response from the base station, based on an association between a beam failure recovery request (BFRR) response and the BFRR.	"monitoring one or more available candidate beams in which to receive the BFRR response from the base station, where the BFRR response is associated with the BFRR." APPLE-1014, claim 1; *see also* [0074], [0080], FIGS. 5B, 6A.

III. 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. APPLE-1003, ¶¶61-64. 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. APPLE-1003, ¶¶61-64. 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*. 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.[2] *Id*., ¶¶61-64. For example, International Patent Publication No. WO 2017/024516, filed on August 11, 2015 ("Lu") (APPLE-1011), discloses the recovery from beam failure in a wireless access network, where a beamforming technique is used in communication between network elements. APPLE-1011, Abstract; APPLE-1003, ¶¶61-64. 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. APPLE-1011, [058]-[067], FIG. 3; APPLE-1003, ¶¶61-64.

B. 3GPP Proposed Standard

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

The 3rd Generation Partnership Project (3GPP) is a well-known standards organization that helps to create standards for telecommunications technologies. APPLE-1003, ¶¶65-67. Generally, the 3GPP holds working group meetings several times a year to propose and discuss new standards and/or changes to existing standards. *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.

APPLE-1006, p. 4; APPLE-1016, ¶¶46-50; APPLE-1003, ¶¶65-67.

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). APPLE-1003, ¶¶65-67. The meeting document (R1-1710596, APPLE-1006) was made publicly available on the 3GPP

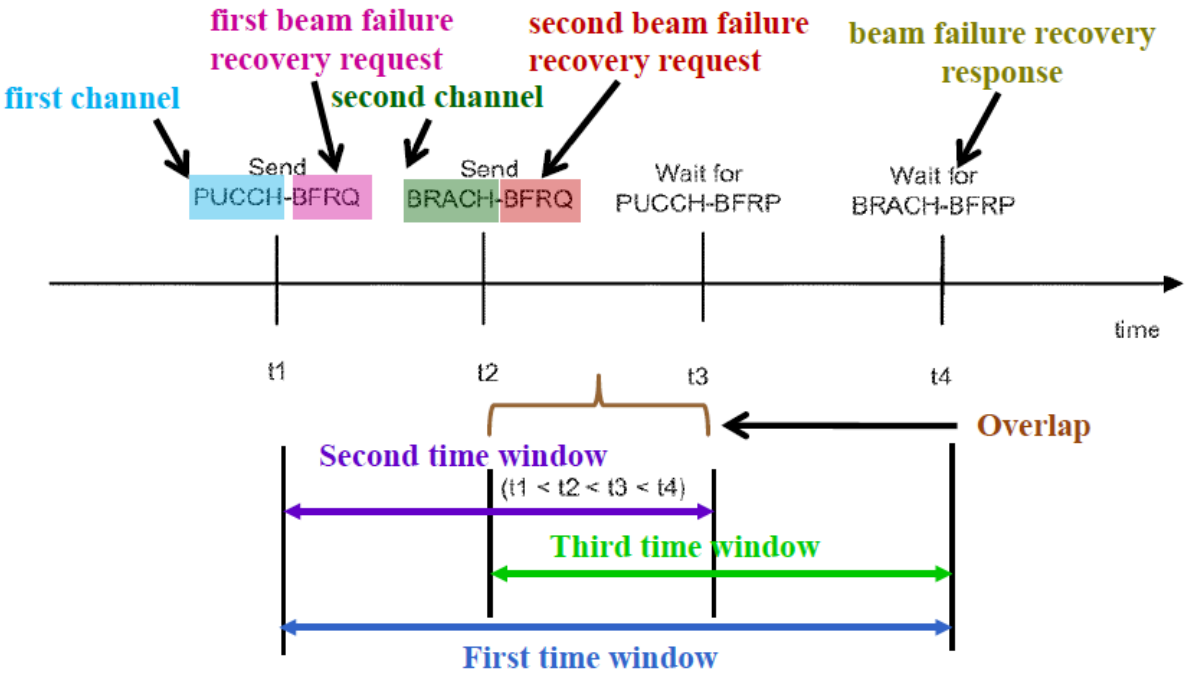
website on June 16, 2017. *See* APPLE-1010, 23; APPLE-1016, ¶¶46-50. Two months later, the alleged priority application of the '113 patent was filed on August 11, 2017, describing "Proposal 7" from the R1-1710596 document and other already well-known concepts. APPLE-1003, ¶¶65-67.

C. Patent Literature Implementing Proposed Standard

Between June 16, 2017, and August 11, 2017, several patent applications were filed on "Proposal 7." APPLE-1003, ¶¶68-77. For example, Xia[3] discloses a method in a UE where multiple beam failure recovery requests are transmitted to a base station. APPLE-1004, [0091]; APPLE-1012, [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. APPLE-1004, [0076]; APPLE-1012, [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

[3] Xia is prior art to the '113 patent based on its provisional filing date of August 10, 2017. 35 U.S.C. §§ 102(a)(2). Claim 1 of Xia is supported by at least claims 1 and 2, paragraphs [0001], [0004]-[0009], [0062], [0065], [0067], [0073]-[0078], [0083]-[0085], and FIG. 5B and 6 of the Xia Provisional (APPLE-1012); and parallel citations to the Xia Provisional are provided herein for Xia citations. APPLE-1003, ¶54-55.

second beam failure recovery request to the base station using a **second channel** (e.g., **PRACH**). APPLE-1004, [0091]-[0093], [0097]-[0103], [0105]-[0106], FIGS. 6B, 7A-7B; APPLE-1012, [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. APPLE-1004, [0102]; APPLE-1012, [0084]-[0085], FIG. 6.

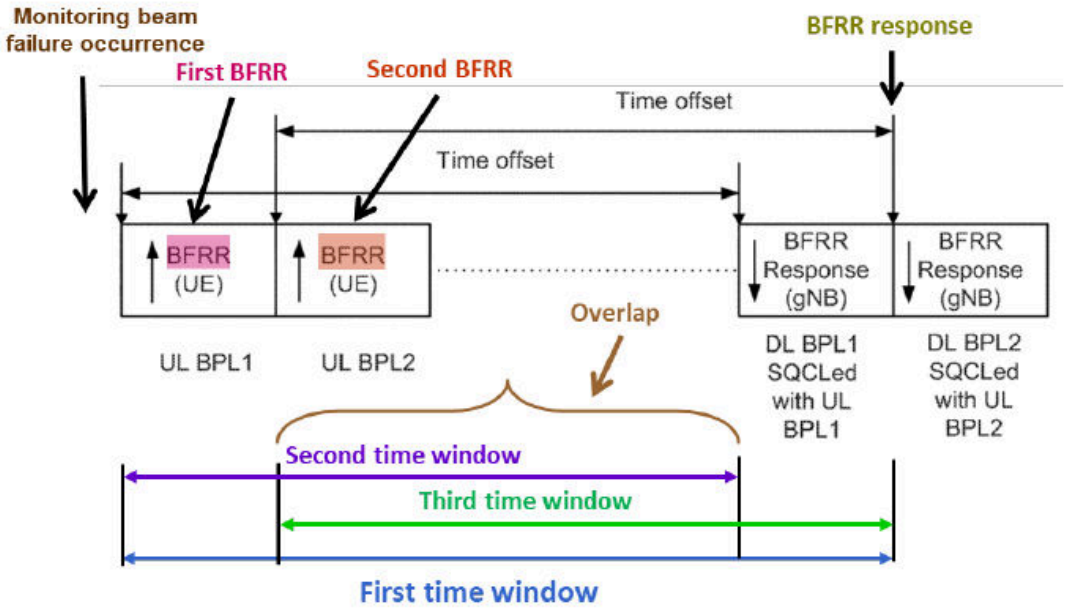


APPLE-1004, FIG. 6B (annotated); APPLE-1012, FIG. 6.

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**. APPLE-1004, [0102], [0084]; APPLE-1012, [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). APPLE-1003, ¶¶68-71.

As another example, Liu similarly discloses a method for beam failure recovery in user equipment. APPLE-1007, [0005]; APPLE-1014, [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). APPLE-1007, [0084], [0098]-[0101], FIG. 5B; APPLE-1014, [0062], [0073]-[0076], FIG. 5B. Liu also discloses that the UE monitors for a **BFRR response** to the two beam failure recovery requests. APPLE-1007, [0096], [0099]; APPLE-1014, [0071], [0074].



APPLE-1007, FIG. 5B (annotated); APPLE-1014, 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**. APPLE-1007, [0084], [0096]-[0099], FIG. 5B; APPLE-1014, [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). APPLE-1007, [0084], [0096]-[0099], FIG. 5B; APPLE-1014, [0062], [0071]-[0074]; APPLE-1003, ¶¶72-77.

Liu is analogous art to the ’113 patent because Liu, 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." APPLE-1007, [0002]; APPLE-1014, [0001]; APPLE-1001, 1:16-59; APPLE-1003, ¶¶72-77.

D. Jover

U.S. Patent Application Publication No. 2015/0141026 to Jover ("Jover") (APPLE-1005), published May 21, 2015. Jover is prior art to the '113 patent based on its publication date under 35 U.S.C. §§ 102(a)(1) and (a)(2).

Jover discloses detecting a communication impairment (*e.g.*, a connection failure) between an endpoint device (*e.g.*, a UE) and a base station. APPLE-1005, [0040]. Jover explains 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 300." APPLE-1005, [0039]. In one example, Jover discloses that the communication impairment is detected by "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." APPLE-1005, [0040].

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. APPLE-1005, [0001]-[0003], [0039]-[0040]; APPLE-1001, 1:16- 59; APPLE-1003, ¶¶78-80.

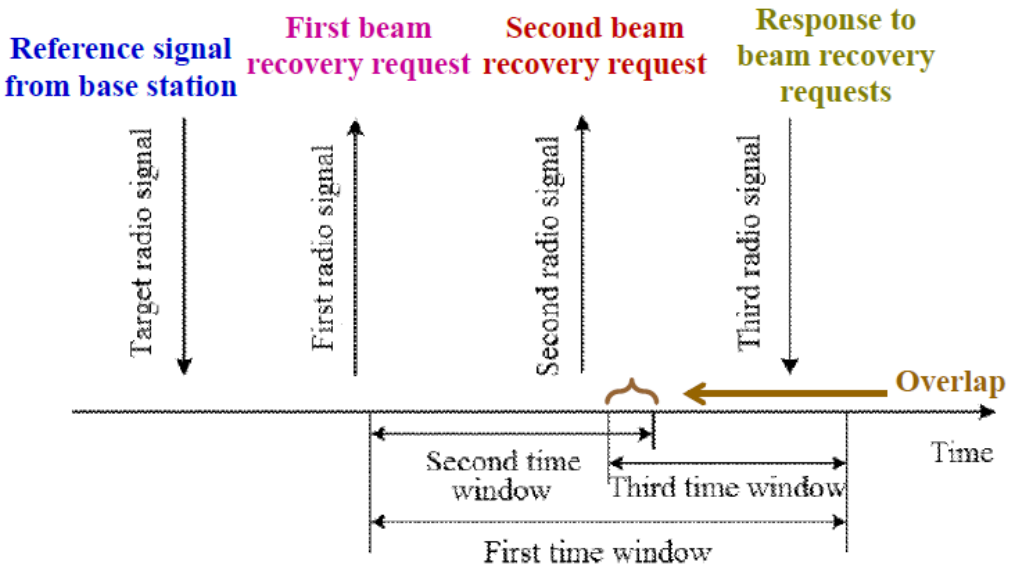
IV. THE '113 PATENT

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. Like Xia and Liu, the '113 patent addresses a beam failure between a UE and a base station in a wireless communication system. APPLE-1001, 1:43-52. Also like Liu, 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. APPLE-1001, 5:9-18, 23:48-54, 2:23-24; APPLE-1003, ¶¶81-83.

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). APPLE-1001, 2:1- 3, 8:57-65; APPLE-1003, ¶¶81-83. The base station receives both requests and then sends a **beam recovery response**, as shown in annotated FIG. 6 below.

APPLE-1001, 10:47- 49, 10:63-64; APPLE-1003, ¶¶81-83.



APPLE-1001, 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). APPLE-1001, 2:3-7; APPLE-1003, ¶¶81-83. 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). APPLE-1001, 12:7-9, 22:51-56, 9:55-56; APPLE-1003, ¶¶81-83. 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. APPLE-1002, 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. APPLE-1002, 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)." APPLE-1002, 153-154, 156-159. The Examiner subsequently allowed the claims, but again without the benefit of Liu, the prior art applied in this Petition, or any other reference mentioned above. APPLE-1002, 123-142, 172-182. As explained above and below, at least Liu discloses the exact limitations the Applicant argued were not in the prior art.

C. IPR History

The '113 patent was the subject of an instituted IPR (consolidated IPR2023-00601 and IPR2023-00602), which terminated after oral hearing upon settlement. IPR2023-00602 involved Liu-Jover as an obviousness ground. The Liu-Jover

ground is provided herein.

D. 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); APPLE-1003, ¶¶86-94.[4]

In IPR2023-00602,[5] to the Board, Apex advanced the following constructions:

Prior PTAB Constructions – Apex Beam	
Claim Term	**PO's Proposed Constructions**
triggering the transmission	causing the transmission
first time window	a period of time from the first radio signal in which to receive a third radio signal (i.e., a response to either the first or second radio signals)
second time window	a period of time from the first radio signal in which to transmit the second radio signal

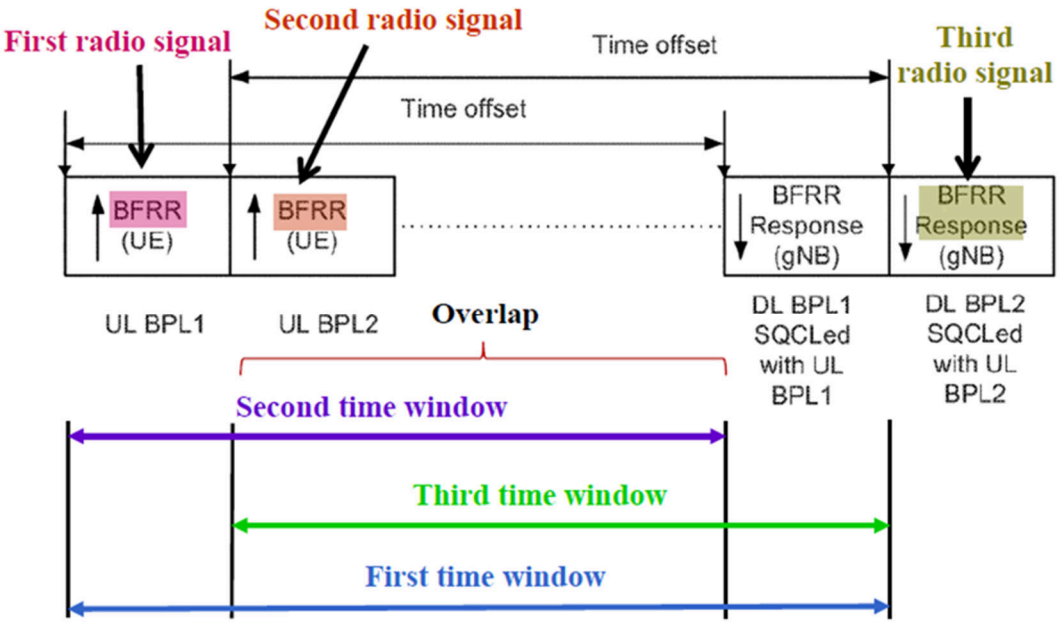
[4] Petitioner reserves the right to argue in an appropriate forum that certain limitations in the challenged claims are indefinite.

[5] IPR2023-00602, Paper 16, 11-17; *see also id.*, EX2007 (PO's Demonstratives), 5-9.

third time window	a period of time from the second radio signal in which to receive a third radio signal (i.e., a response to either the first or second radio signals)

Resolution of these constructions would not inform the applicability of the grounds presented in this IPR. The prior art renders obvious "causing" the transmission of a first radio signal and a second radio signal. For example, Liu alone or in combination with Jover transmits multiple beam failure recovery requests (BFRR) based on beam failure detection reference signal measurements. APPLE-1007, [0005], [0078], [0082]-[0085], [0099], FIG. 5B, FIG. 6A-D; APPLE-1014, [0004], [0056], [0062], [0090]; APPLE-1003, ¶¶86-94.

Liu in view of Jover also renders obvious the time window limitations, as discussed in more detail herein. By way of brief example, Liu's UE transmits first and second radio signals within the claimed time windows, and monitors for the third radio signal within a third time window, as shown in FIG. 5B below:



APPLE-1007, FIG. 5B (annotated); APPLE-1003, ¶¶86-94.

As can be seen from FIG. 5B above, and as described in more detail herein, Liu in view of Jover renders the "time windows" obvious. Thus, no construction is necessary or warranted to resolve the dispute because the prior art renders this limitation obvious.

Additionally, Apple disagrees with the proposed construction of the triggering limitation because it merely swaps the word "triggering" for the word "causing," thereby adding nothing. No ambiguity exists in the limitation; but if there were any, merely swapping one word for another, synonymous does not add clarity to the limitation.

Apple disagrees with the above proposed constructions for the first and third time windows. First, no construction is necessary beyond the plain meaning.

There is no ambiguity in the claim language itself, and the specification provides not indication of lexicography. Second, the claims do not require that the third radio signal be received during the first time window; indeed, the claims do not recite receiving the third radio signal at all. Rather, the claims require a first time window during which time the UE monitors for the third radio signal. The proposed construction is an improper attempt to inject words into the claim, practice routinely rejected by the Federal Circuit. *E.g.*, *Source Vagabond Sys.*, 753 F.3d at 1299. The proposed construction would change the scope of the claim from "monitoring" to "receiving," and is an alternation more appropriately undertaken by a claim amendment.

Apple also disagrees with the proposed second time window. Neither the specification nor claims limits the "second time window" in terms of the "second radio signal," let alone requires that it be defined as "the period of time from the first radio signal in which to transmit the second radio signal." The claim simply requires that "a time domain resource occupied by the second radio signal is within the second time window," and nothing more.

Apex previously advanced separate constructions in the parallel District Court litigation adverse to Samsung:

Claim Term	PO's Proposed Constructions

"time window"	"the time allocated to respond to a signal request"

APPLE-1030, 17, 38; IPR2023-00602, Paper 18, 9-11. To support the construction of "time window," Apex argued that the definition of window is "a time interval." APPLE-1030, 39 ("window: 1. A time interval during which an activity may take place. Also a time interval during which an activity must take place….").

Given that Apex has advanced various constructions at different times in different forums, it would be impossible now to predict what constructions they might offer in the future. Accordingly, Petitioner reserves the right to respond to new claim constructions that Apex advances in this proceeding.

V. LEVEL OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art (POSITA) would have had at least a electrical engineering, computer engineering, computer science, or a similar field, along with two years of experience designing or developing wireless networks. APPLE-1003, ¶¶95-98. Additional education might substitute for some of the experience, and additional substantial experience might substitute for some of the educational background. *Id*. A POSITA would also have familiarity with the 3GPP LTE standards, and would have understood how to search through the available Technical Specifications for implementing RAN

technologies. *Id*.

VI. THE CHALLENGED CLAIMS ARE UNPATENTABLE OVER THE PRIOR ART

A. Claims 1-20 Are Obvious over Liu in View of Jover

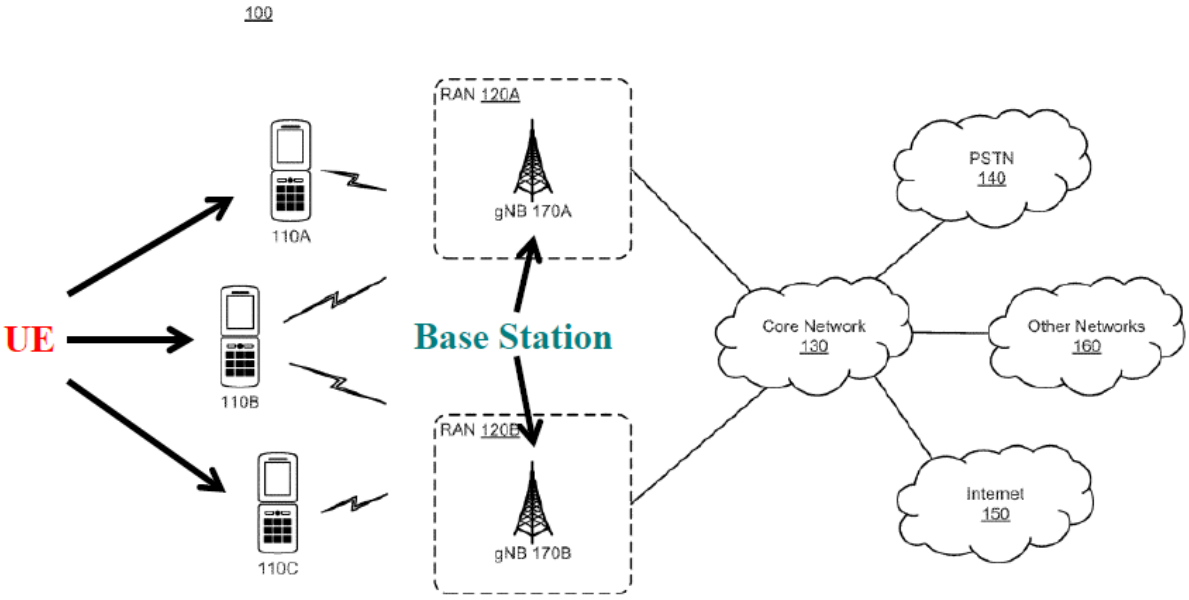
1. Independent Claim 1

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

To the extent the preamble is limiting, Liu discloses a method in a user equipment (UE) for wireless communication. APPLE-1003, ¶¶100-101. As shown in annotated FIG. 1 below, Liu 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." APPLE-1007, [0056];[6] APPLE-1014, [0034]. Liu 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." APPLE-1007, [0059]; APPLE-1014, [0037]. Liu further explains that

[6] 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.

"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." APPLE-1007, [0060]; APPLE-1014, [0038]; APPLE-1003, ¶¶100-101.



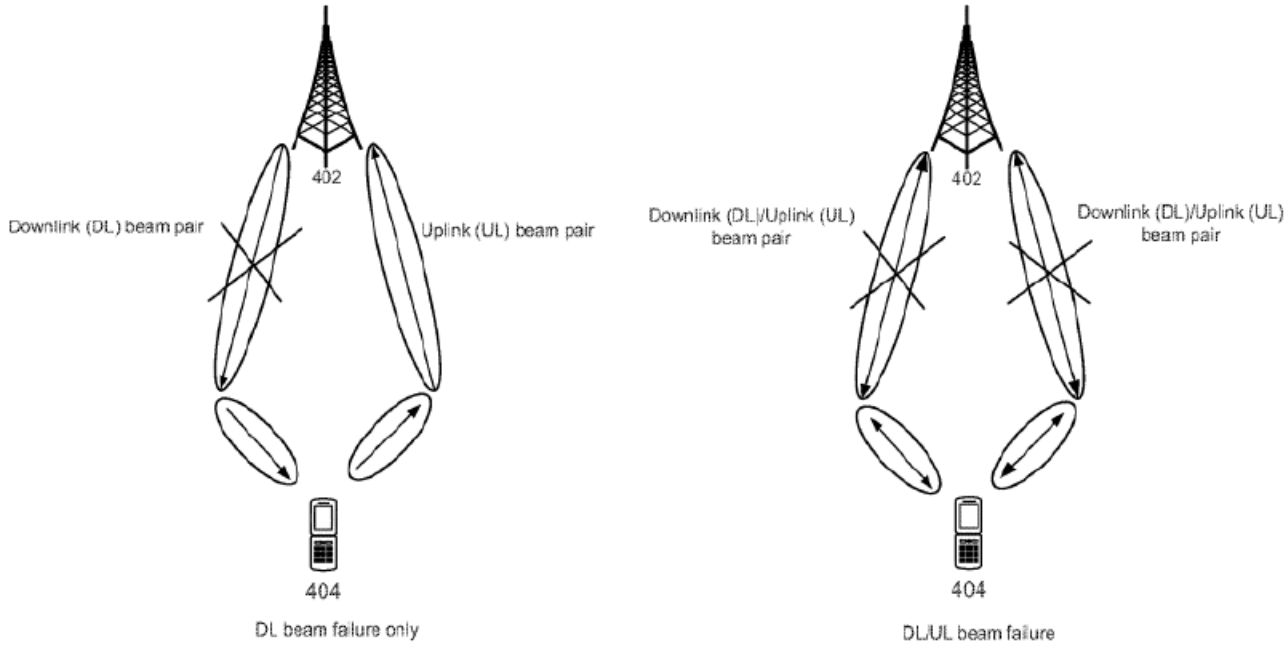
APPLE-1007, FIG. 1 (annotated); APPLE-1014, FIG. 1.

One wireless communication method described in Liu is "a method for beam failure recovery in user equipment." APPLE-1007, [0005]; APPLE-1014, [0004]. Liu's method includes, among other things, "sending a beam failure recovery request (BFRR) to the base station upon detection of a beam failure between the base station and the user equipment; and monitoring one or more candidate beams

in which to receive a BFRR response from the base station, based on an association between a beam failure recovery request (BFRR) response and the BFRR." APPLE-1007, [0005]; *see also* APPLE-1007, [0032], [0033], [0103]; APPLE-1014, [0004], [0032]; *see also*, [0017], [0077]; APPLE-1003, ¶¶100-101. This method in a UE for wireless communication is described in more detail below.

a) [1a]: "receiving a target radio signal;"

Liu discloses that the UE receives a target radio signal, which it calls a "reference signal" from the base station. APPLE-1007, [0069]-[0070]; APPLE-1014, [0047]-[0048]; APPLE-1003, ¶¶102-104. As shown in FIGS. 4A and 4B below, Liu discloses that "the base station 402 and user equipment 404 communicate via DL [downlink] beam pairs and UL [uplink] beam pairs." APPLE-1007, [0075]; APPLE-1014, [0053].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." APPLE-1007, [0075]; *see also* APPLE-1007, [0067], [0068], FIG. 2; APPLE-1014, [0053]; *see also* APPLE-1014, [0045],[0046], FIG. 2.



APPLE-1007, FIGS. 4A (left) and 4B (right); APPLE-1014, FIGS. 4A, 4B.

According to Liu, "a beam failure is detected by the user equipment 110A-110C." APPLE-1007, [0103]; APPLE-1014, [0078]. Liu discloses that "[i]f the user equipment 110A-110C does not support Rx beamforming, the user equipment 110A-110C measures the channel quality of a reference signal (RS) in each transmission beam and reports the measurements to the base station 202." APPLE-1007, [0069]; APPLE-1014, [0047]. Liu further discloses "[i]f the user equipment 110A-110C is configured to support Rx beamforming, the user equipment 110A-110C measures the channel qualities of multiple Tx beams received from the base station 202 for each reception beam pattern and reports a total or some high-ranked measurements of all Tx-Rx beam pairs to the base station 202." APPLE-1007, [0069]; APPLE-1014, [0047]. Liu's reference signal can be a "channel state

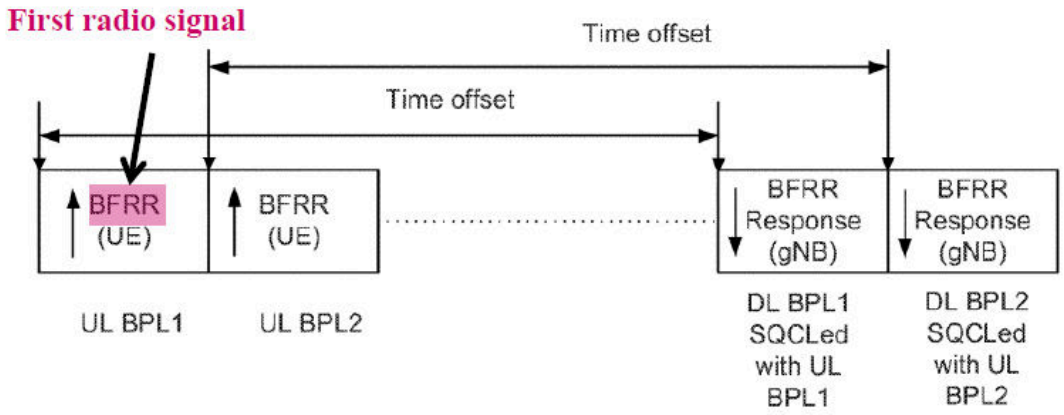
information- reference signal (**CSI-RS**).” APPLE-1007, [0087], [0091]; APPLE-1014, [0068]. Liu also discloses that the UE receives a “**synchronization signal** from base station 402.” APPLE-1007, [0076]-[0077]; APPLE-1014, [0054]-[0055]. A POSITA would understand that Xia receives the beam failure detection RS because the UE detects the beam failure and reports detection of the beam failure. APPLE-1003, ¶¶102-104; APPLE-1007, [0103], [0069]; APPLE-1014, [0078], [0047].

The ’113 patent’s 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.” APPLE-1001, 2:23-36. Thus, Liu’s reference signal, such as the CSI-RS or the synchronization signal, constitutes the claimed “target reference signal.” APPLE-1003, ¶¶102-104.

b) [1b]: “transmitting a first radio signal on a first channel;”

Liu discloses that “[i]n order for the system to recover from such a beam failure, the user equipment 404 sends a beam failure recovery request (BFRR) to the base station 402.” APPLE-1007, [0084]; APPLE-1014, [0062]. According to

Liu, in some cases, "the user equipment 404 may transmit multiple BFRRs in UL beam pairs (e.g., [UL BPL1, UL BPL2])." APPLE-1007, [0099]; *see also* APPLE-1007, [0098], [0100]-[0102], [0105], [0114]; APPLE-1014, [0074]; *see also* APPLE-1014, [0073], [0075]-[0076], [0082], [0090]. As shown, the UE transmits a first BFRR ("**first radio signal**") to the base station on a first channel. APPLE-1003, ¶¶105-107.



APPLE-1007, FIG. 5B (annotated); APPLE-1014, FIG. 5B.

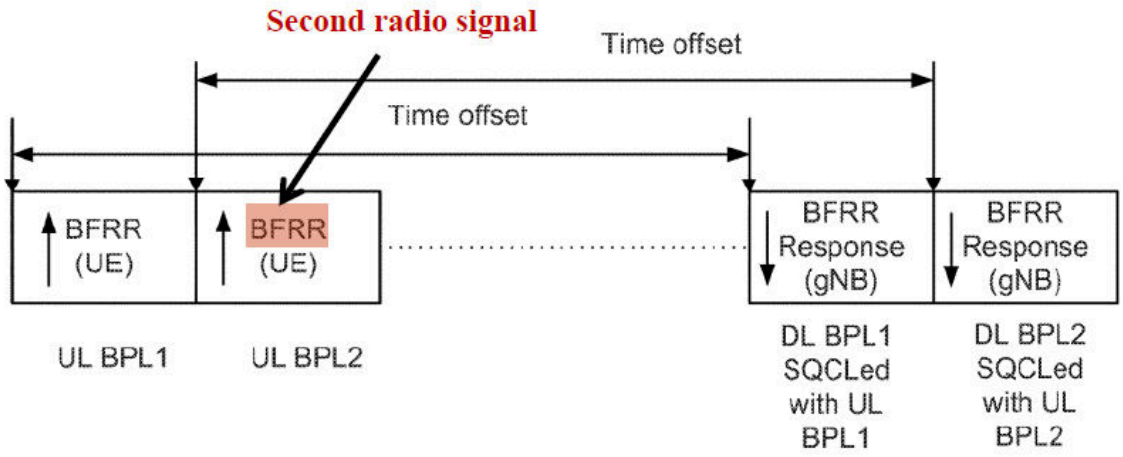
Specifically, Liu discloses that "the user equipment 404 may use the active PUCCH (originally allocated for UCI) to report the beam failure and request recovery from the base station 402." APPLE-1007, [0084]; *see also* APPLE-1007, [0004]; APPLE-1014, [0062]; *see also* APPLE-1014, [0003].

The '113 patent's specification states that the claimed "first radio signal" can be a "beam recovery request." APPLE-1001, 3:41-42, *see also* APPLE-1001, 13:66-67. The '113 patent also states that "the first channel" can be "a PUCCH."

APPLE-1001, 8:57. Accordingly, Liu's first BFRR constitutes the claimed "first radio signal," and Liu's PUCCH constitutes the claimed "first channel." APPLE-1003, ¶¶105-107.

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

After the first BFRR is sent, Liu discloses that the UE transmits a second BFRR ("**second radio signal**") to the base station on a second channel, as shown in annotated FIG. 5B below. APPLE-1003, ¶¶108-111.



APPLE-1007, FIG. 5B (annotated);APPLE-1014, FIG. 5B.

As discussed above, Liu discloses that "the user equipment 404 may transmit multiple BFRRs in UL beam pairs (e.g., [UL BPL1, ULBPL2])." APPLE-1007, [0099], FIG. 5B; APPLE-1014, [0074], FIG. 5B. The first BFRR may be sent through the "PUCCH," as discussed for claim [1b]. In addition, Liu explains that the UE may also use a "Physical Random Access Channel (PRACH) or

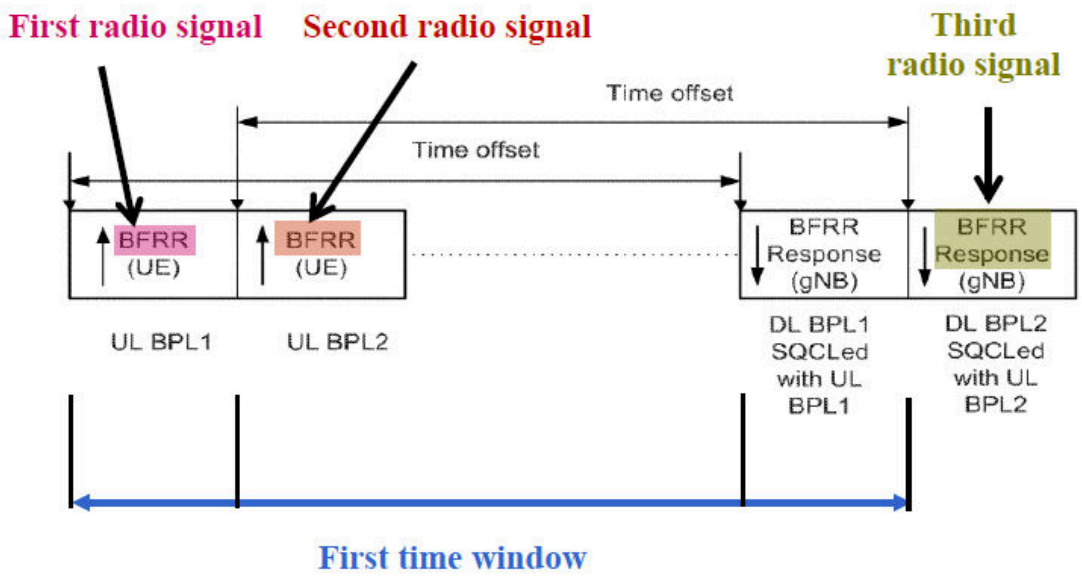
"PRACH-like" channel for BFRR. APPLE-1007, [0004], [0084], [0092]; APPLE-1014, [0003], [0062], [0069].

The '113 patent's specification states that the claimed "second radio signal" can be a "beam recovery request[]." APPLE-1001, 13:66-67. The '113 patent also states that "the second channel" can be "a physical layer random access channel." APPLE-1001, 8:64-65. Therefore, Liu's second BFRR constitutes the claimed "second radio signal," and Liu's PRACH constitutes the claimed "second channel." APPLE-1003, ¶¶108-111.

To the extent Patent Owner argues Liu does not expressly disclose that the first BFRR is sent through the PUCCH and the second BFRR is sent through the PRACH, it would have been obvious, as explained below for claim [3]. *See infra* claim [3]. APPLE-1003, ¶¶108-111.

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

After sending the first and second BFRRs, Liu's UE monitors for a BFRR response ("**third radio signal**") from the base station in a time window ("**first time window**") from the starting point of the depicted time offset for the first BFRR response to the end point of the depicted time offset for the second BFRR response, as shown in annotated FIG. 5B below. APPLE-1007, [0099]; APPLE-1014, [0074]; APPLE-1003, ¶¶112-118.



APPLE-1007, FIG. 5B (annotated); APPLE-1014, FIG. 5B.

Liu's UE may monitor for the BFRR response in a number of ways, including: "(1) monitoring the SQCL'ed DL beam pairs for the BFRR response simultaneously (if the user equipment 404 Rx capability permits), (2) monitoring the 'best' SQCL'ed DL beam pair (e.g., the candidate beam having the best channel quality) for the BFRR response, [or] (3) indicating a preferred DL beam pair in the BFRR to the base station 402, in which the user equipment 404 monitors the indicated DL beam pair according to the time offset (in this case, the user equipment 404 may only monitor one DL beam, so a recommendation is made as to the best performing beam)." APPLE-1007, [0099]; APPLE-1014, [0074].

Liu further discloses that "each BFRR is associated with a BFRR response," or "all BFRRs are associated with one BFRR response." APPLE-1007, [0119]; APPLE-1014, [0095]. Thus, Liu acknowledges that there may

be a single BFRR response for both the first and second BFRR, or alternatively, there may be a BFRR response for each of the first and second BFRRs. APPLE-1003, ¶¶112-118; *see also*, APPLE-1007, FIG. 5B; APPLE-1014, FIG. 5B.

The '113 patent's 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." APPLE-1001, 10:47-49, 10:63-64. Thus, either the second BFRR response or both the first and second BFRR responses in Liu constitute the claimed "third radio signal."

Moreover, as shown in annotated FIG. 5B above, Liu monitors the BFRR response in a "first time window" between the starting point of the depicted time offset for the first BFRR response and the end point of the depicted time offset for the second BFRR response. APPLE-1003, ¶¶112-118. For example, Liu explains that "a transmission occasion association between the BFRR (sent by the user equipment 404) and the BFRR response (sent by the base station 2402) is used to monitor the DL beams." APPLE-1007, [0096]; APPLE-1014, [0071]. Liu also discloses that "the transmission occasion association is indicated by a time offset such that UE should monitor the DL beams for the BFRR response from the base station 402, which is SQCL'ed with the BFRR from the user equipment 404, in a time slot with a

time offset relative to the BFRR." APPLE-1007, [0096]; APPLE-1014, [0071]. Liu further explains that the time slot is a time window for UE monitoring BFRR response and the time offset indicates the starting position of the response monitoring window relative to the BFRR. APPLE-1007, [0096], [0029], [0054], FIG. 5B; APPLE-1014, [0071], [0013], [0032], FIG. 5B. Liu's UE thus monitors for one or more BFRR responses in the "first time window," as claimed. APPLE-1003, ¶¶112-118; *see also* APPLE-1006, 1-4; APPLE-1021, 1; APPLE-1016, ¶¶52-57.

e) [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;"

Liu in combination with Jover renders obvious this limitation. APPLE-1003, ¶¶119-125.

Liu discloses that a detection of a beam failure triggers transmission of the first and second BFRRs ("first radio signal" and "second radio signal") to the base station. APPLE-1007, [0005], [0078], [0084], [0114]; APPLE-1014, [0004], [0056], [0062], [0090]. Liu also discloses that the UE measures "the channel quality" of the reference signal, such as a CSI-RS or a synchronization signal ("target radio signal"). APPLE-1007, [0069], [0076]-[0077], [0087], [0091]; APPLE-1014, [0047], [0054]-[0055], [0091]. Liu establishes causality between

detecting a beam failure and transmitting the first and second radio signals (e.g., the first and second BFRRs). For example, Liu contemplates "sending a beam failure recovery request (BFRR) to the base station upon detection of a beam failure between the base station and the user equipment." APPLE-1007, [0005], [0114]; APPLE-1014, [0004], [0090]. Liu also explains that, "[i]n order for the system to recover from such a beam failure, the user equipment 404 sends a beam failure recovery request (BFRR) to the base station 402." APPLE-1007, [0084], FIG. 6A; APPLE-1014, [0062], FIG. 6A.

The claims also provide further evidence. Claim 1 states "sending a beam failure recovery request (BFRR) to a base station upon detection of a beam failure between the base station and the user equipment"; claim 5 states "upon detection of the beam failure, the BFRR is sent using a physical uplink control channel (PUCCH)"; and claim 7 states "upon detection of the beam failure, the BFRR is sent using a physical random access channel (PRACH) or a PRACH-like channel." APPLE-1007, claims 1, 5, 7; APPLE-1014, claims 1, 6, [0069].

A POSITA would have found it obvious to modify Liu's method to determine the beam failure based on a triggering condition with a predetermined threshold, as taught by Jover. APPLE-1003, ¶¶119-125. For example, Jover discloses detecting a communication impairment (e.g., a connection failure) between an endpoint device (e.g., a UE) and a base station. APPLE-1005, [0040].

Jover explains 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 300." APPLE-1005, [0039]. In one example, Jover discloses that the communication impairment is detected by "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." APPLE-1005, [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." APPLE-1005, [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. APPLE-1003, ¶¶119-125.

It would have been obvious to implement Jover's teachings in Liu's method to use a beam failure triggering condition with BER as the target measurement value, as taught by Jover. APPLE-1005, [0039]-[0040]; APPLE-1003, ¶¶119-125. Both Liu and Jover involve wireless communications between a UE and a base station. APPLE-1007, FIG. 1; APPLE-1014, FIG. 1; APPLE-1005, FIG. 1. Both references are also specifically directed to detecting a communication failure between the UE and the base station. APPLE-1007, [0005], [0069], [0076]-[0078],

[0084], [0087], [0091], [0114], FIG. 1; APPLE-1014, [0004], [0047], [0054]-[0056], [0062], [0090], FIG. 1; APPLE-1005, [0039]-[0040], FIG. 3; APPLE-1003, ¶¶119-125. And Jover provides further detail about how the communication failure is determined, explaining that it may be determined by using a target measurement value (BER) that is higher than a target threshold (1%) as a triggering condition. APPLE-1005, [0039]-[0040]; APPLE-1003, ¶¶119-125.

A POSITA would have been motivated to adopt Jover's triggering condition in Liu's method to determine when to send the first and second BFRRs. Liu already discloses that the transmission of the first and second BFRRs to the base station are triggered by the detection of a communication failure. APPLE-1003, ¶¶119-125. And Jover simply provides further details about how and when to implement Liu'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 also would have been motivated to implement Jover's triggering condition in Liu's method to improve the accuracy and reliability of the beam failure determination. Id. For example, a triggering condition based on BER would have provided threshold measurements to ensure a beam failure detection is appropriate. *Id.* (citing APPLE-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. APPLE-1003, ¶¶119-125 (citing APPLE-1009 (Pandey), 463 (disclosing that "[t]he most meaningful criterion for evaluation of performance of communication systems is the bit error rate (BER)")); APPLE-1015; APPLE-1013 (Vembu), 7:25-32, 7:37-47. Thus, a POSITA would have been motivated to implement Jover's triggering condition in Liu's method because of the advantages provided by Jover's triggering condition. APPLE-1003, ¶¶119-125. *See KSR*, 550 U.S. at 417 ("[I]f a technique has been used to improve one device, and a [POSITA] 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.

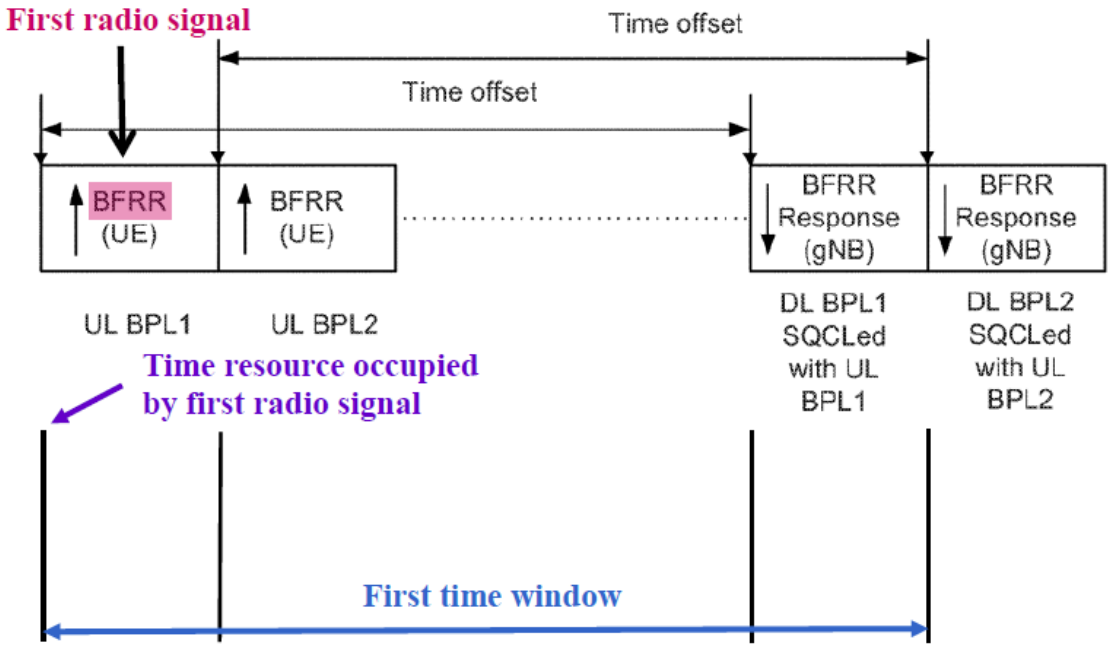
A POSITA would have had a reasonable expectation of success as it would have been straightforward for a POSITA to implement Jover's triggering condition in Liu's method. APPLE-1003, ¶¶119-125. As mentioned above, both Liu and Jover include similar components that perform similar functions, and both Liu 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.*, APPLE-1009 (Pandey), 463-466; APPLE-1013 (Vembu), 7:25-32, 37-47. Thus, it would have been straightforward to add Jover's triggering condition (BER) to Liu's existing method. APPLE-1003, ¶¶119-125. Further, implementing Jover's teachings in Liu 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, Liu in combination Jover renders obvious limitation [1e]. APPLE-1003, ¶¶119-125.

f) [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. 5B below, Liu discloses that a time resource occupied by the first radio signal (first BFRR) is used for determining the start time of the first time window. APPLE-1003, ¶¶126-128.



APPLE-1007, FIG. 5B (annotated); APPLE-1014, FIG. 5B.

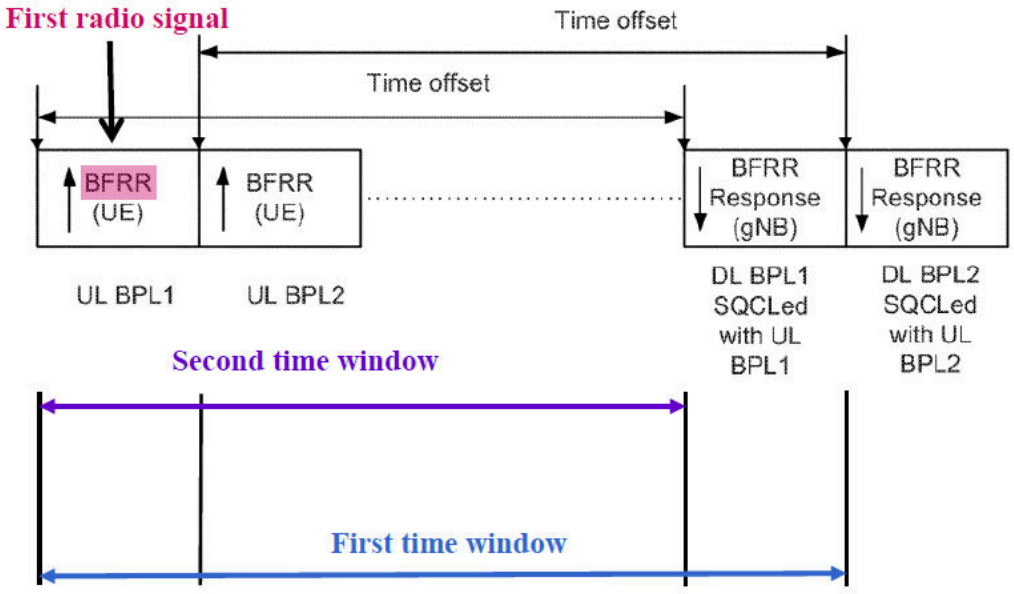
A POSITA would have understood "a time resource occupied by the first radio signal" to include a start time of the first radio signal. APPLE-1003, ¶¶126-128. This is consistent with the '113 patent, which explains that time domain resources of the first and second signals can be start times of the time windows. APPLE-1001, 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"). APPLE-1003, ¶¶126-128.

Further, as discussed above for claim [1d], Liu discloses monitoring for a BFRR response in the "first time window," and that monitoring begins in response

to the first BFRR. Thus, as shown above in FIG. 5B, a time resource occupied by the first BFRR, for example, the start time of the first BFRR, is used for determining the start time of the first time window. APPLE-1003, ¶¶126-128.

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

As shown in annotated FIG. 5B below, Liu discloses that a time domain resource occupied by the first radio signal (e.g., beginning at the starting point of the first BFRR) is used for determining a second time window (the depicted time offset for the first BFRR). APPLE-1003, ¶¶129-131.



APPLE-1007, FIG. 5B (annotated); APPLE-1014, FIG. 5B.

As discussed above for claim [1d], Liu discloses that "the transmission occasion association is indicated by a time offset such that UE should monitor the DL beams for the BFRR response from the base station 402, which is SQCL'ed

with the BFRR from the user equipment 404, in a time slot with a time offset relative to the BFRR." APPLE-1007, [0096]; APPLE-1014, [0071]. Thus, the depicted time offset for the first BFRR represents a "second time window" that begins in response to the first BFRR. APPLE-1003, ¶¶129-131.

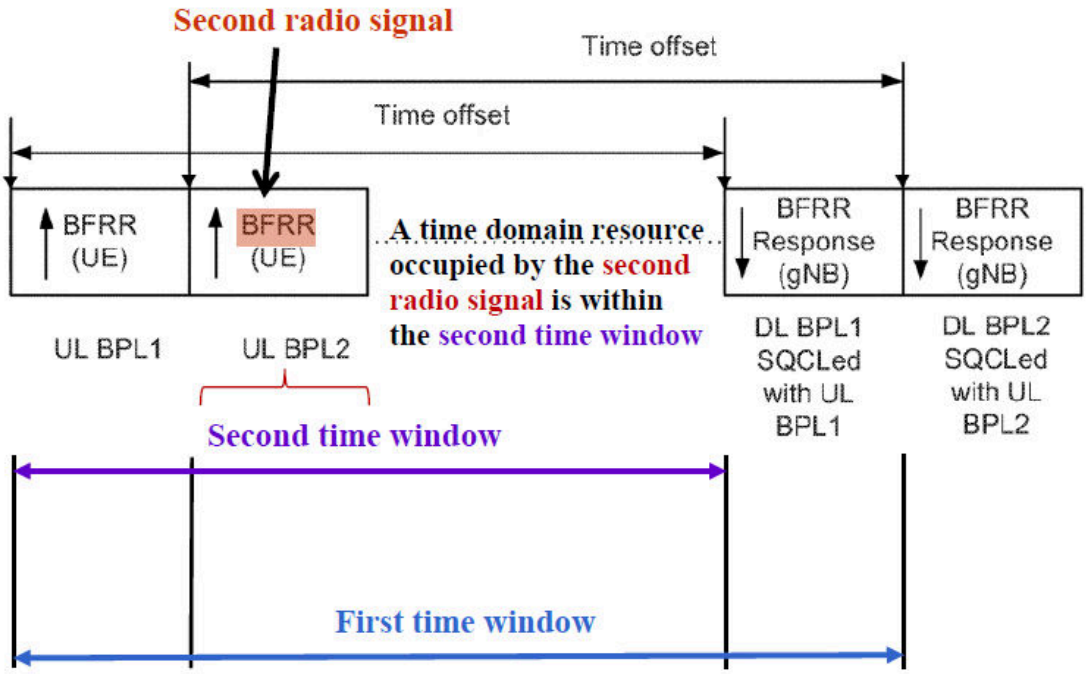
The '113 patent's specification states that "the start time of the second time window and the start time of the first time window are the same." APPLE-1001, 9:23-25. Just like the '113 patent, in Liu, the start time of the second time window and the start time of the first time window are the same. APPLE-1003, ¶¶129-131.

Liu in view of JOver renders [1g] obvious even when applying Apex's previous construction for the second time window. As shown in annotated FIG. 5B above, Liu discloses a period of time (the depicted time offset for the first BFRR) from the first radio signal (first BFRR) in which to transmit the second radio signal (second BFRR). APPLE-1003, ¶¶129-131.

h) [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. 5B below, Liu discloses that a time domain resource occupied by the second radio signal (e.g., beginning at the starting point of the second BFRR) is within the second time window. APPLE-1003, ¶132. Further, as shown in the figure, the second time window (the depicted time offset for the first BFRR) is within the first time window (from the starting point of the

depicted time offset for the first BFRR response to the end point of the depicted time offset for the second BFRR response).



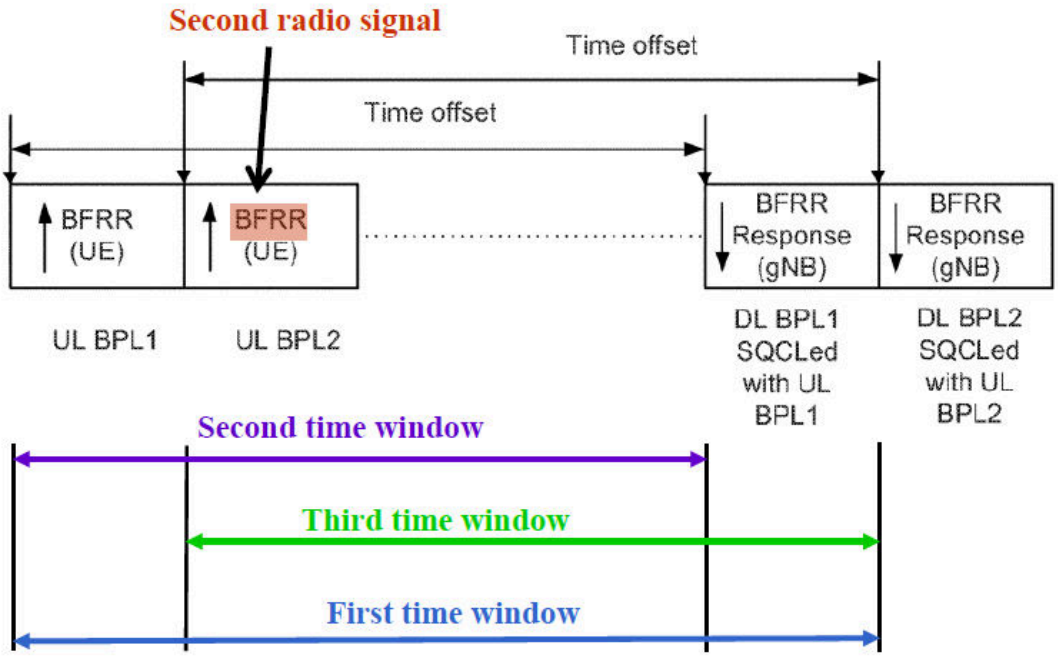
APPLE-1007, FIG. 5B (annotated); APPLE-1014, FIG. 5B.

APPLE-1003, ¶132.

i) [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. 5B below, Liu discloses that a time domain resource occupied by the second radio signal (e.g., beginning at the starting point of the second BFRR) is used for determining a third time window (the depicted time offset for the second BFRR). APPLE-1003, ¶¶133-135. Also, as shown in the

figure below, the end time of the third time window is the end time of the first time window. *Id.*



APPLE-1007, FIG. 5B (annotated); APPLE-1014, FIG. 5B.

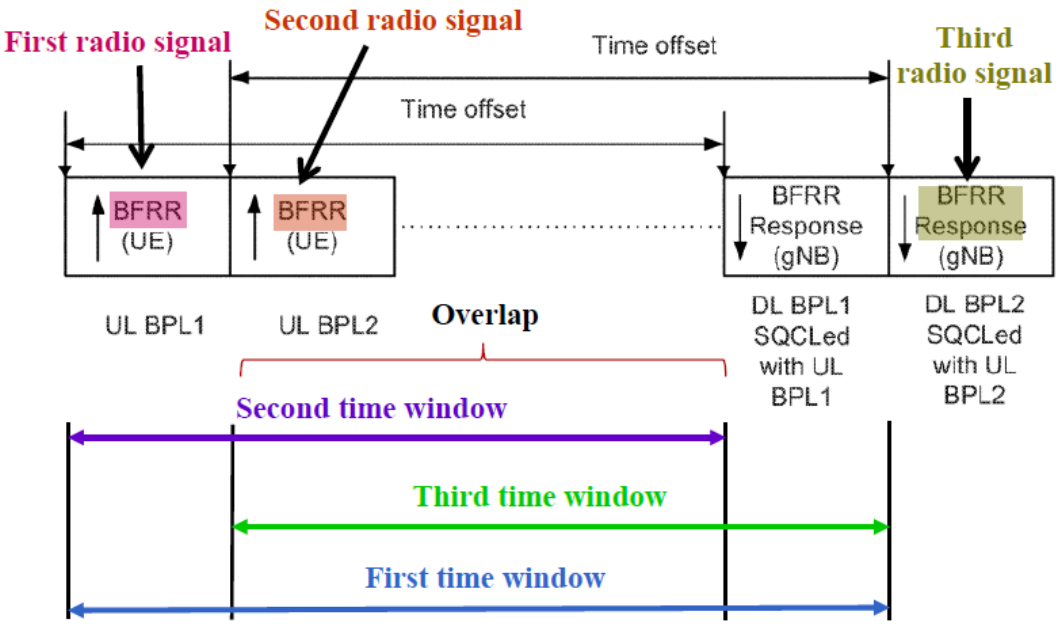
As discussed above for claim [1d], Liu discloses that "the transmission occasion association is indicated by a time offset such that UE should monitor the DL beams for the BFRR response from the base station 402, which is SQCL'ed with the BFRR from the user equipment 404, in a time slot with a time offset relative to the BFRR." APPLE-1007, [0096]; APPLE-1014, [0071]. Thus, the depicted time offset for the second BFRR represents a "third time window" that begins in response to the second BFRR. APPLE-1003, ¶¶133-135.

As also discussed above for claim [1d], Liu acknowledges that there may be

a single BFRR response for both the first and second BFRR, or alternatively, there may be a BFRR response for each of the first and second BFRRs. APPLE-1007, [0119], FIG. 5B; APPLE-1014, [0095], FIG. 5B. 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 BFRR response. Thus, as illustrated in FIG. 5B, both the "first time window" and the "third time window" end when the BFRR response is received. APPLE-1003, ¶¶133-135.

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

As shown in annotated FIG. 5B below, Liu discloses that the second time window (the depicted time offset for the first BFRR) and the third time window (the depicted time offset for the second BFRR) have overlapped time domain resource(s). APPLE-1003, ¶¶136-137.



APPLE-1007, FIG. 5B (annotated); APPLE-1014, FIG. 5B.

Therefore, Liu in combination with Jover renders obvious claim 1. APPLE-1003, ¶¶136-137.

2. Claim 2

b. [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, Liu in combination with Jover renders obvious claim 1. Liu further discloses a multiple-input multiple-output (MIMO) system with multiple antenna arrangements in the base station and the user equipment. APPLE-1007, [0061], [0088], [0093], FIG. 4C; APPLE-1014, [0039], [0063]-[0066]; APPLE-1003, ¶¶138-143.

As discussed for claim [1d], Liu's base station transmits one or more BFRR responses ("third radio signal") in response to the two BFRRs. Liu also discloses that each BFRR sent from the UE may indicate a preferred DL beam pair in the BFRR to the base station. APPLE-1007, [0099]; APPLE-1014, [0074]. Liu further explains that the UE monitors and identifies a "candidate beam" that may be used by the base station. APPLE-1014, [0084]-[0089]; APPLE-1014, [0007], [0063]-[0065]; APPLE-1003, ¶¶138-143.

Liu further discloses that the base station's downlink (DL) BFRR response beam is quasi co-located with the UE's uplink (UL) BFRR beam. APPLE-1003, ¶¶138-143. Specifically, Liu discloses that "in the event of a beam failure, the user equipment 404 sends a BFRR in the UL beam pair (UL BPL) to the base station 402," and [i]n return, the base station 402 responds with a BFRR response in the DL beam pair (DL BPL) that is SQCL'ed with the UL beam pair used for BFRR transmission by the user equipment 404." APPLE-1007, [0096]; APPLE-1014, [0071]. As a result, the "UE should monitor the DL beams for the BFRR response from the base station 402, which is SQCL'ed with the BFRR from the user equipment 404, in a time slot with a time offset relative to the BFRR." APPLE-1007, [0096]; APPLE-1014, [0071]; APPLE-1003, ¶¶138-143.

Thus, in Liu, the multi-antenna related transmitting of the BFRR response from the base station is determined based on the UL BFRR from the UEs. APPLE-

1003, ¶¶138-143. And, because there are two BFRRs, determining the multi-antenna related transmitting of the BFRR response can be based on one of three scenarios: (1) based on the first BFRR; (2) based on the second BFRR; or (3) based on both the first and second BFRRs. APPLE-1003, ¶¶138-143. In other words, in Liu, at least one signal of the following set of signals {first BFRR, second BFRR} is used for determining a multi-antenna related transmitting of the BFRR response. APPLE-1003, ¶¶138-143; *see also* APPLE-1006, 1; APPLE-1021, 1, FIG. 4; APPLE-1016, 52-57.

a) [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, Liu discloses this limitation in scenario (3) discussed above, where the multi-antenna related transmitting of the BFRR is based on both the first and second BFRRs. APPLE-1003, ¶¶144-145; *see also* APPLE-1007, [0119] ("all BFRRs are associated with one BFRR response."); APPLE-1014, [0095].

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, Liu in combination with Jover renders obvious claim 1. As discussed for claim [1b] and claim [1c], Liu's PUCCH (Physical Uplink Control Channel) constitutes the claimed "first channel," and Liu'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. APPLE-1003, ¶¶146-149.

To the extent Patent Owner argues that Liu does not expressly disclose that the first BFRR is sent through a PUCCH and the second BFRR is sent through a PRACH, it would have been obvious. APPLE-1003, ¶¶146-149. Indeed, Liu discloses sending multiple BFRRs and the ability to use both PUCCH and PRACH channels for a given BFRR. APPLE-1007, [0004], [0084], [0092], [0099]; APPLE-1014, [0003], [0062], [0069], [0074]; APPLE-1003, ¶¶146-149. Thus, it would have been a matter of simple design choice between two known alternatives (using a PUCCH channel or a PRACH channel), which was well within the skill of a POSITA. APPLE-1003, ¶¶146-149; *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).

A POSITA would have been motivated to use different channels for the first and second BFRRs to ensure greater reliability of the base station's response. APPLE-1003, ¶¶146-149. For example, if the PUCCH is being used to send the first BFRR and await a subsequent response, the second BFRR can be sent through the PRACH. *Id.* Further, different channels may be used so that both BFRRs can be sent simultaneously. *Id.*

A POSITA would have had a reasonable expectation of success as it would have been straightforward for a POSITA to modify Liu's method so that the first BFRR is sent through a PUCCH and the second BFRR is sent through a PRACH. APPLE-1003, ¶¶146-149. As mentioned above, Liu already discloses sending multiple BFRRs and the ability to use both PUCCH and PRACH channels for a given BFRR. APPLE-1007, [0004], [0084], [0092], [0099]; APPLE-1014, [0003], [0062], [0069], [0074]; APPLE-1003, ¶¶146-149. Thus, it would have been straightforward for a POSITA to use one channel for the first BFRR and another channel for the second BFRR. *Id.*

4. Claim 4

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

As discussed above, Liu in combination with Jover renders obvious claim 1. As discussed for claims [1b] and [3], Liu's PUCCH (Physical Uplink Control Channel) constitutes the claimed "first channel." The PUCCH is a physical layer control channel, as claimed. APPLE-1003, ¶150.

5. Claim 5

b. [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, Liu in combination with Jover renders obvious claim 1. As discussed for claim 2, Liu further discloses that the base station's BFRR response beam is quasi co-located with the UE's BFRR beam. For example, Liu discloses that "the base station 402 responds with a BFRR response in the DL beam pair (DL BPL) **that is SQCL'ed with** the UL beam pair used for BFRR transmission by the user equipment 404." APPLE-1007, [0096]; APPLE-1014, [0071]; APPLE-1003, ¶¶151-153.

A POSITA would have understood that, because the base station's BFRR response beam is quasi co-located with the UE's BFRR beam, the antenna port(s) for the BFRR response is SQCL'ed with the antenna port(s) for the BFRRs. APPLE-1003, ¶¶151-153 (citing APPLE-1022, 1 (defining "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." APPLE-1007, [0088]; APPLE-1016, ¶¶58-63.

As discussed above for claim 2, in Liu, determining the multi-antenna related transmitting of the BFRR response can be based on one of three scenarios: (1) based on the first BFRR; (2) based on the second BFRR; or (3) based on both the first and second BFRRs. APPLE-1003, ¶¶151-153. In scenarios (1) and (3), the first BFRR ("first radio signal") is used for determining the antenna port group used for transmitting the BFRR response ("third radio signal"), as claimed. *Id.* 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.*

a) [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*, 265 F.3d at 1351; APPLE-1003, ¶¶154.

6. Independent Claim 6

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

As discussed for claim [1pre], Liu discloses a wireless communication system in which a UE communicates with a base station. APPLE-1007, [0056]-[0060]; APPLE-1014, [0034]-[0038]. In particular, Liu discloses a "base station that may implement the methods and teachings according to this disclosure." APPLE-1007, [0111]; APPLE-1014, [0087]. And, although this wireless communication method is primarily described from the perspective of the UE, Liu

also discloses the corresponding method performed by the base station because the method involves the UE wirelessly interfacing with the base station. APPLE-1003, ¶155. 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.*

a) [6a]: "transmitting a target radio signal;"

As discussed for claim [1a], Liu's UE receives a reference signal ("target radio signal") from a base station. APPLE-1007, [0069]-[0070], [0087], [0091], [0076]- [0077]; APPLE-1014, [0047]-[0048], [0054]-[0055]. Thus, Liu also discloses the base station "transmitting a target radio signal." APPLE-1003, ¶156.

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

As discussed for claim [1b], Liu's UE transmits a first BFRR ("first radio signal") to the base station via a PUCCH ("first channel"). APPLE-1007, [0084], [0098]- [0104], [0105], [0114]; APPLE-1014, [0062], [0073]-[0076], [0078]-[0079], [0082], [0090]. Liu further discloses that, in response to the BFRR, the base station transmits a BFRR response. APPLE-1007, [0084], [0086], [0096], [0098], [0099], [0106], [0119], FIG. 5B; APPLE-1014, [0062]-[0064], [0070]-[0074], [0079]-[0081], [0095], FIG. 5B. A POSITA would have understood that,

because the base station sends a response, it must have received the request. APPLE-1003, ¶157. Thus, Liu also discloses the base station "receiving a first radio signal on a first channel." *Id.*

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

As discussed for claim [1c], Liu discloses, or in the alternative, renders obvious that the UE transmits a second BFRR ("second radio signal") to the base station via a PRACH ("second channel"). APPLE-1007, [0084], [0098]-[0104], [0105], [0114]; APPLE-1014, [0062], [0073]-[0076], [0078]-[0079], [0082], [0090]. Liu further discloses that, in response to the BFRR, the base station transmits a BFRR response. APPLE-1007, [0084], [0086], [0096], [0098], [0099], [0106], [0119], FIG. 5B; APPLE-1014, [0062]-[0064], [0070]-[0074], [0079]-[0081], [0095], FIG. 5B. A POSITA would have understood that, because the base station sends a response, it must have received the request. Thus, Liu also discloses, or in the alternative, renders obvious the base station "receiving a second radio signal on a second channel." APPLE-1003, ¶158.

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

As discussed for claim [1d], Liu's UE monitors a BFRR response ("third radio signal") from the base station in a time window from the starting point of the

depicted time offset for the first BFRR in FIG. 5B and the end point of the depicted time offset for the second BFRR in FIG. 5B ("first time window"). APPLE-1007, [0096], [0099], FIG. 5B; APPLE-1014, [0071], [0074], FIG. 5B. Liu further discloses that the base station transmits a BFRR response in the first time window. APPLE-1007, [0084], [0086], [0096], [0098], [0099], [0106], [0119], FIG. 5B; APPLE-1014, [0062]-[0064], [0070]-[0074], [0079]-[0081], [0095], FIG. 5B. Thus, Liu also discloses the base station "transmitting a third radio signal in a first time window." APPLE-1003, ¶159.

e) [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], Liu in combination with Jover renders this limitation obvious. APPLE-1003, ¶160.

f) [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], Liu discloses this limitation. APPLE-1003, ¶161.

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

As discussed for claim [1g], Liu discloses this limitation. APPLE-1003, ¶162.

h) [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], Liu discloses this limitation. APPLE-1003, ¶163.

i) [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], Liu discloses this limitation. APPLE-1003, ¶164.

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

As discussed for claim [1j], Liu discloses this limitation. APPLE-1003, ¶144. Therefore, Liu in combination with Jover renders obvious claim 6. APPLE-1003, ¶¶165-166.

7. Claim 7

a) [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, Liu in combination with Jover renders obvious claim 6. As discussed for claim [2a], Liu discloses this additional limitation of claim [7a]. APPLE-1003, ¶167.

b) [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], Liu discloses this additional limitation of claim [7b]. APPLE-1003, ¶168.

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, Liu in combination with Jover renders obvious claim 6. As discussed for claim 3, Liu discloses, or in the alternative, renders obvious this additional limitation of claim 8. APPLE-1003, ¶169.

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, Liu in combination with Jover renders obvious claim 6. As discussed for claim 4, Liu discloses this additional limitation of claim 9. APPLE-1003, ¶170.

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, Liu in combination with Jover renders obvious claim 6. As discussed for claim [5a], Liu discloses this additional limitation of claim [10a]. APPLE-1003, ¶171.

b) [10b]: "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."

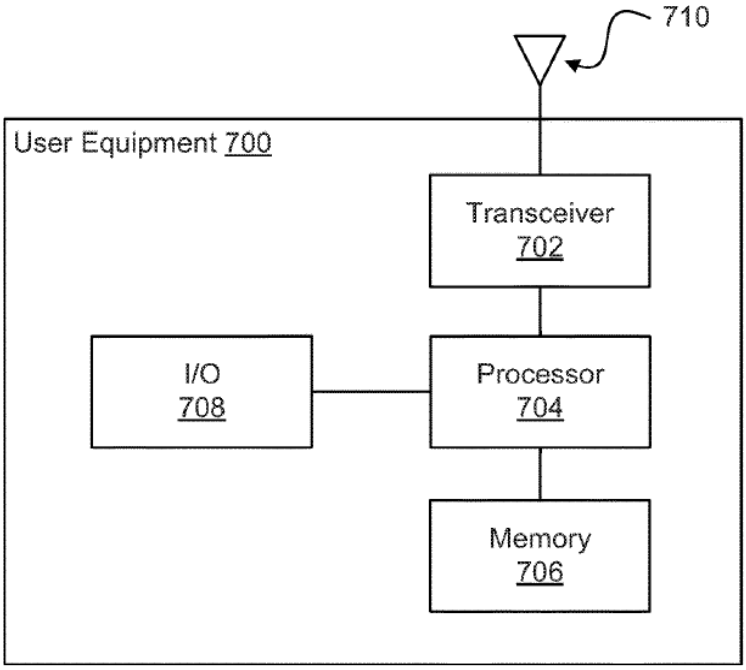
Claim 10 includes an "or" between claim [10a] and [10b], so nothing beyond the above-discussed teachings is required to satisfy claim 10. *Brown*, 265 F.3d at 1351; APPLE-1003, ¶172.

11. Independent Claim 11

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

As discussed for claim [1pre], Liu discloses a wireless communication system in which a UE communicates with a base station. APPLE-1007, [0056]-[0060]; APPLE-1014, [0034]-[0038]. Liu also discloses "a method for beam failure recovery in user equipment." APPLE-1007, [0005]; APPLE-1014, [0004]; APPLE-1003, ¶¶173-178.

Liu further discloses the structure of the UE and how it is used for wireless communication. APPLE-1003, ¶¶173-178. As shown in FIG. 7A below, the UE 700 includes at least one processor 704, at least one transceiver 702, one or more input/output devices 708, at least one antenna 710, and at least one memory 706. *See* APPLE-1007, [0107]-[0110]; APPLE-1014, [0083]-[0086], FIG. 7A.



APPLE-1007, FIG. 7A; APPLE-1014, FIG. 7A.

Liu discloses that "one or multiple transceivers 702 could be used in the UE 700," and that "a transceiver 702 may also be implemented using at least one transmitter and at least one separate receiver." APPLE-1007, [0108]; APPLE-1014, [0084]. Thus, Liu's UE has one or more transmitters and one or more receivers. APPLE-1003, ¶¶173-178. Liu further discloses that "[e]ach transceiver

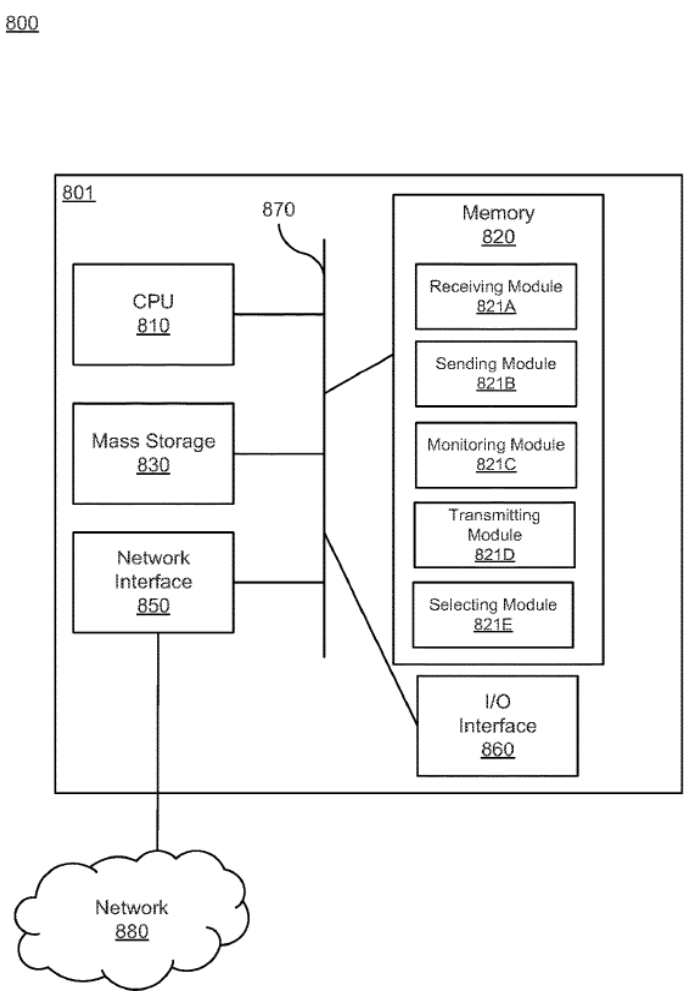
702 may include any suitable structure for generating signals for wireless transmission and/or processing signals received wirelessly." APPLE-1007, [0108]; APPLE-1014, [0084].

In addition, each transceiver 702 (or separate transmitter/receiver) is "configured to demodulate data or other content received by the at least one antenna 710," and "[e]ach antenna 710 includes any suitable structure for transmitting and/or receiving wireless signals." APPLE-1007, [0108]; APPLE-1014, [0084]. Thus, a POSITA would have understood that each antenna in Liu's UE may be associated with a transmitter and a receiver. APPLE-1003, ¶¶173-178.

Moreover, as discussed for claim [2a], Liu discloses a MIMO system, including multiple antenna arrangements in the user equipment. APPLE-1007, [0061], [0088], [0093], FIG. 4C; APPLE-1014, [0039], [0063]-[0066]. Thus, a POSITA would have understood that, with a multiple antenna arrangement, Liu's UE would have multiple transmitters and multiple receivers for transmitting and receiving wireless signals. APPLE-1003, ¶¶173-178. 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. *Id.*

As shown in FIG. 8 below, Liu also discloses a network device 800 that may

be used to facilitate communications between the UE and the base station. APPLE-1007, [0113]; APPLE-1014, [0089]; APPLE-1003, ¶¶173-178. A POSITA would have understood that this network device 800 can be part of the UE. APPLE-1003, ¶¶173-178. The network device 800 includes a memory 820 that includes a "receiving module 821A receiving spatial quasi co-located information between a downlink beam pair and an uplink beam pair from a base station and receiving an association indication between the downlink beam pair for a beam failure recovery request (BFRR) response and the uplink beam pair for the BFRR," "a transmitting module 821D transmitting multiple BFRRs in two or more uplink beam pairs simultaneously and transmitting multiple BFRRs in the uplink beam pairs in time division duplex (TDD)," "a sending module 821B sending a BFRR to the base station upon detection of a beam failure between the base station and the user equipment," and "a monitoring module 821C monitoring one or more available candidate beams in which to receive the BFRR response from the base station, where the BFRR response is associated with the BFRR." APPLE-1007, [0114]; APPLE-1014, [0090], FIG. 8.



APPLE-1007, FIG. 8; APPLE-1014, FIG. 8.

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

As discussed for claim [1a], Liu's UE receives a target radio signal. Liu discloses the claimed "first receiver module" in at least two ways. APPLE-1003, ¶¶179-181.

First, as discussed for claim [11pre], Liu's UE can have multiple receivers for receiving wireless signals. Thus, a POSITA would understand that a first one of

the receivers in Liu's UE constitutes "a first receiver module, to receive a target radio signal." APPLE-1003, ¶¶179-181.

Second, as also discussed for claim [11pre], Liu's UE can also include a receiving module 821A for receiving beam information from the base station. Thus, a POSITA would understand that Liu's receiving module 821A constitutes "a first receiver module, to receive a target radio signal." APPLE-1003, ¶¶179-181.

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

As discussed for claim [1b], Liu's UE transmits a first radio signal on a first channel. Liu discloses the claimed "second transmitter module" in at least two ways. APPLE-1003, ¶¶172-184.

First, as discussed for claim [11pre], Liu's UE can have multiple transmitters for transmitting wireless signals. Thus, a POSITA would understand that a first one of the transmitters in Liu's UE constitutes "a second transmitter module, to transmit a first radio signal on a first channel." APPLE-1003, ¶¶172-184.

Second, as also discussed for claim [11pre], Liu's UE can also include a sending module 821B for sending a BFRR to the base station. Thus, a POSITA would understand that Liu's sending module 821B constitutes "a second transmitter module, to transmit a first radio signal on a first channel." APPLE-1003, ¶¶172-184.

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

As discussed for claim [1c], Liu discloses, or in the alternative, renders obvious that the UE transmits a second radio signal on a second channel. Liu discloses, or in the alternative, renders obvious the claimed "third transmitter module" in at least two ways. APPLE-1003, ¶¶185-187.

First, as discussed for claim [11pre], Liu'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. APPLE-1003, ¶¶185-187. Thus, a POSITA would understand that a second one of the transmitters in Liu's UE discloses, or in the alternative, renders obvious "a third transmitter module, to transmit a second radio signal on a second channel." *Id*.

Second, as also discussed for claim [11pre], Liu's UE can also include a transmitting module 821D for transmitting multiple BFRRs. Thus, a POSITA would understand that Liu's transmitting module 821D discloses, or in the alternative, renders obvious "a third transmitter module, to transmit a second radio signal on a second channel." APPLE-1003, ¶¶185-187.

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

As discussed for claim [1d], Liu's UE monitors a third radio signal in a first time window. Liu discloses the claimed "fourth receiver module" in at least two ways. APPLE-1003, ¶¶188-190.

First, as discussed for claim [11pre], Liu'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. APPLE-1003, ¶¶188-190. Thus, a POSITA would understand that a second one of the receivers in Liu'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], Liu's UE can also include a monitoring module 821C for monitoring the BFRR response from the base station. Thus, a POSITA would understand that Liu's monitoring module 821C constitutes "a fourth receiver module, to monitor a third radio signal in a first time window." APPLE-1003, ¶¶188-190.

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], Liu in combination with Jover renders this limitation obvious. APPLE-1003, ¶191.

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], Liu discloses this limitation. APPLE-1003, ¶192.

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], Liu discloses this limitation. APPLE-1003, ¶193.

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], Liu discloses this limitation. APPLE-1003, ¶194.

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], Liu discloses this limitation. APPLE-1003, ¶195.

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

As discussed for claim [1j], Liu discloses this limitation. APPLE-1003, ¶¶196-197.

Therefore, Liu in combination with Jover renders obvious claim 11. APPLE-1003, ¶¶196-197.

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, Liu in combination with Jover renders obvious claim 11. As discussed for claim [2a], Liu discloses this additional limitation of claim [12a]. APPLE-1003, ¶198.

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], Liu discloses this additional limitation of claim [12b]. APPLE-1003, ¶199.

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, Liu in combination with Jover renders

obvious claim 11. As discussed for claim 3, Liu discloses, or in the alternative, renders obvious this additional limitation of claim 13. APPLE-1003, ¶200.

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, Liu in combination with Jover renders obvious claim 11. As discussed for claim 4, Liu discloses this additional limitation of claim 14. APPLE-1003, ¶201.

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, Liu in combination with Jover renders obvious claim 11. As discussed for claim [5a], Liu discloses this additional limitation of claim [15a]. APPLE-1003, ¶202.

b) 15[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 15 includes an "or" between claim [15a] and [15b], so nothing beyond the above-discussed teachings is required to satisfy claim 15. *Brown*, 265 F.3d at 1351; APPLE-1003, ¶¶203.

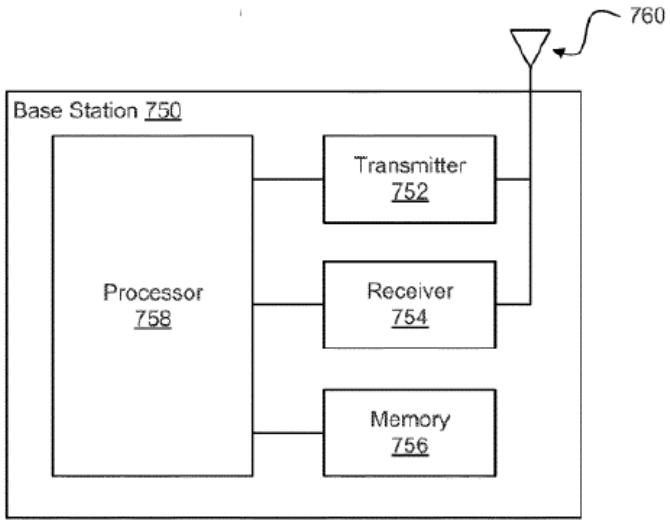
16. Independent Claim 16

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

As discussed for claim [6pre], Liu discloses a wireless communication system in which a UE communicates with a base station. APPLE-1007, [0056]-[0060]; APPLE-1014, [0034]-[0038]. Liu also discloses a "base station that may implement the methods and teachings according to this disclosure." APPLE-1007, [0111]; APPLE-1014, [0087]; APPLE-1003, ¶¶204-207.

Liu further discloses the structure of the base station and how it is used for

wireless communication. As shown in FIG. 7B below, the base station 750 includes at least one processor 758, at least one transmitter 752, at least one receiver 754, one or more antennas 760, and at least one memory 756. *See* APPLE-1007, [0111]-[0112]; APPLE-1014, [0087]-[0088], FIG. 7B; APPLE-1003, ¶¶204-207.



APPLE-1007, FIG. 7B; APPLE-1014, FIG. 7B.

Liu discloses that "[e]ach transmitter 752 includes any suitable structure for generating signals for wireless transmission to one or more UEs or other devices," while "[e]ach receiver 754 includes any suitable structure for processing signals received wirelessly from one or more UEs or other devices." APPLE-1007, [0112]; APPLE-1014, [0088]. Liu further discloses that "[e]ach antenna 760 includes any suitable structure for transmitting and/or receiving wireless signals," and that "one or more antennas 760 could be coupled to the transmitter(s) 752, and one or more

separate antennas 760 could be coupled to the receiver(s) 754." APPLE-1007, [0112]; APPLE-1014, [0088]. Thus, a POSITA would have understood that each antenna in Liu's base station may be associated with a transmitter and a receiver. APPLE-1003, ¶¶204-207.

Moreover, as discussed for claim [2a], Liu discloses a MIMO system, including multiple antenna arrangements in the base station. APPLE-1007, [0061], [0088], [0093], FIG. 4C; APPLE-1014, [0039], [0063]-[0066]. Thus, a POSITA would have understood that, with a multiple antenna arrangement, Liu's base station would have multiple transmitters and multiple receivers for transmitting and receiving wireless signals. APPLE-1003, ¶¶204-207. 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], Liu's base station transmits a target radio signal. Further, as discussed for claim [16pre], Liu's base station can have multiple transmitters for transmitting wireless signals. Thus, a POSITA would understand that a first one of the transmitters in Liu's base station constitutes "a first

transmitter module, to transmit a target radio signal." APPLE-1003, ¶208.

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

As discussed for claim [6b], Liu's base station receives a first radio signal on a first channel. Further, as discussed for claim [16pre], Liu's base station can have multiple receivers for receiving wireless signals. Thus, a POSITA would understand that a first one of the receivers in Liu's base station constitutes "a second receiver module, to receive a first radio signal on a first channel." APPLE-1003, ¶209.

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

As discussed for claim [6c], Liu discloses, or in the alternative, renders obvious the base station receives a second radio signal on a second channel. Further, as discussed for claim [16pre], Liu'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. APPLE-1003, ¶210. Thus, a POSITA would understand that a second one of the receivers in Liu's base station discloses, or in the alternative, renders obvious "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], Liu's base station transmits a third radio signal in a first time window. Further, as discussed for claim [16pre], Liu'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. APPLE-1003, ¶211. Thus, a POSITA would understand that a second one of the transmitters in Liu'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], Liu in combination with Jover renders this limitation obvious. APPLE-1003, ¶212.

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], Liu discloses this limitation. APPLE-1003, ¶213.

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], Liu discloses this limitation. APPLE-1003, ¶214.

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], Liu discloses this limitation. APPLE-1003, ¶215.

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], Liu discloses this limitation. APPLE-1003, ¶216.

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

As discussed for claim [6j], Liu discloses this limitation. APPLE-1003, ¶196. Therefore, Liu in combination with Jover renders obvious claim 16. APPLE-1003, ¶217-218.

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, Liu in combination with Jover renders obvious claim 16. As discussed for claim [2a], Liu discloses this additional limitation of claim [17a]. APPLE-1003, ¶219.

b) [17b]: "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], Liu discloses this additional limitation of claim [17b]. APPLE-1003, ¶220.

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, Liu in combination with Jover renders obvious claim 16. As discussed for claim 3, Liu discloses, or in the alternative, renders obvious this additional limitation of claim 18. APPLE-1003, ¶221.

19. Claim 19

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

For the reasons discussed above, Liu in combination with Jover renders obvious claim 16. As discussed for claim 4, Liu discloses this additional limitation of claim 19. APPLE-1003, ¶222.

20. Claim 20

e. [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, Liu in combination with Jover renders obvious claim 16. As discussed for claim 5[a], Liu discloses this additional limitation of claim 20[a]. APPLE-1003, ¶223.

a) [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*, 265 F.3d at 1351; APPLE-1003, ¶224.

VII. TRIAL SHOULD BE INSTITUTED

Petitioner believes that discretionary denial is unwarranted, and yet, Petitioner intends to utilize the bifurcated briefing process contemplated by the March 26, 2025, Stewart Memorandum to rebut contentions if offered by Patent Owner to the contrary. *See, e.g.*, APPLE-1032; APPLE-1033; https://uspto.cosocloud.com/p9xpz6s4jn75/ (Video).

IX. CONCLUSION AND FEES

The Challenged Claims are unpatentable. Please charge fees to Deposit Account 06-1050.

X. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8(a)(1)

A. Real Party-In-Interest Under 37 C.F.R. § 42.8(b)(1)

Apple Inc. is the petitioner and the real party-in-interest.

B. Related Matters Under 37 C.F.R. § 42.8(b)(2)

Petitioner is not aware of any disclaimers, reexamination certificates or petitions for inter partes review for the '113 Patent. The '113 Patent is the subject of a number of civil actions including: *Apex Beam Technologies LLC v. Apple Inc*, 6-24-cv-00223 (WDTX), filed April 29, 2024; *Samsung Electronics Co., Ltd. et al. v. Apex Beam Technologies LLC*, IPR2023-00601(PTAB), filed February 28, 2023; *Samsung Electronics Co., Ltd. et al v. Apex Beam Technologies* LLC, IPR2023-00602 (PTAB), filed February 28, 2023; *Apex Beam Technologies LLC v. Samsung Electronics Co., Ltd. et al*, 2-24-cv-00188 (EDTX), filed June 1, 2022; *Apex Beam Technologies LLC v. ZTE Corporation*, 2-22-cv-00031 (EDTX), filed February 1, 2022; *Apex Beam Technologies LLC v. OnePlus Technology (Shenzhen) Co., Ltd.,* 2-22-cv-00032 (EDTX), filed February 1, 2022; *Apex Beam Technologies LLC v. TCT Mobile International Limited et al,* 2-21-cv-00438 (EDTX), filed November 30, 2021.

C. Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)

Petitioner provides the following designation of counsel.

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D. Service Information

Please address all correspondence and service to the address listed above.

Petitioner consents to electronic service by email at IPR50095-0226IP2@fr.com.

Respectfully submitted,

Dated: May 2, 2025

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(Control No. IPR2025-00921)

Attorneys for Petitioner

CERTIFICATION UNDER 37 CFR § 42.24

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter Partes* Review totals 13,735 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated: May 2, 2025

/W. Karl Renner/

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Attorneys for Petitioner

CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on May 2, 2025, a complete and entire copy of this Petition for *Inter Partes* Review, Power of Attorney, and all supporting exhibits were provided via Federal Express, to the Patent Owner by serving the correspondence address of record as follows:

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