AO 120 (Rev. 08/10)

TO:	Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court for the Eastern District of Texas, Marshall Division on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:24-cv-00203	3/20/2024	for the Eastern District of Texas, Marshall Division

PLAINTIFF	DEFENDANT
APEX BEAM TECHNOLOGIES LLC	SAMSUNG ELECTRONICS CO., LTD. and SAMSUNG ELECTRONICS AMERICA, INC.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	11,063,727	7/13/2021	Apex Beam Technologies LLC
2	11,374,721	6/28/2022	Apex Beam Technologies LLC
3	11,457,426	9/27/2022	Apex Beam Technologies LLC
4	11,546,110	1/3/2023	Apex Beam Technologies LLC
5	11,626,904	4/11/2023	Apex Beam Technologies LLC

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
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5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director **Copy 3—Upon termination of action, mail this copy to Director**
Copy 2—Upon filing document adding patent(s), mail this copy to Director **Copy 4—Case file copy**

AO 120 (Rev. 08/10)

TO:	Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court for the Eastern District of Texas, Marshall Division on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:24-cv-00203	3/20/2024	for the Eastern District of Texas, Marshall Division

PLAINTIFF	DEFENDANT
APEX BEAM TECHNOLOGIES LLC	SAMSUNG ELECTRONICS CO., LTD. and SAMSUNG ELECTRONICS AMERICA, INC.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	11,917,581	2/27/2024	Apex Beam Technologies LLC
2	10,965,434	3/30/2021	Apex Beam Technologies LLC
3	11,139,944	10/5/2021	Apex Beam Technologies LLC
4	11,108,639	8/31/2021	Apex Beam Technologies LLC
5	10,986,695	4/20/2021	Apex Beam Technologies LLC

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
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DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:24-cv-00203	3/20/2024	for the Eastern District of Texas, Marshall Division

PLAINTIFF	DEFENDANT
APEX BEAM TECHNOLOGIES LLC	SAMSUNG ELECTRONICS CO., LTD. and SAMSUNG ELECTRONICS AMERICA, INC.

PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 10,979,128	4/13/2021	Apex Beam Technologies LLC
2 11,637,615	4/25/2023	Apex Beam Technologies LLC
3		
4		
5		

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
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Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/113,851	04/13/2021	10979128	2019-006Ut	2812

148908 7590 03/24/2021

ALIREZA BABAEI
4525 Gilbertson Road
Fairfax, VA 22032

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Alireza Babaei, Fairfax, VA;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

IR103 (Rev. 10/09)

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

148908 7590 03/04/2021
ALIREZA BABAEI
4525 Gilbertson Road
Fairfax, VA 22032

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/113,851	12/07/2020	Alireza Babaei	2019-006UT	2812

TITLE OF INVENTION: BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$600	$0.00	$0.00	$600	06/04/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
SMITH, MARCUS	2419	370-329000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Alireza Babaei
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: PanPsy Technologies, LLC

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Fairfax, VA

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ☒ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Alireza Babaei/ Date 2021-03-08

Typed or printed name Alireza Babaei Registration No. 75,833

Electronic Patent Application Fee Transmittal

Application Number:	17113851
Filing Date:	07-Dec-2020
Title of Invention:	BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY
First Named Inventor/Applicant Name:	Alireza Babaei
Filer:	Alireza Babaei
Attorney Docket Number:	2019-006Ut

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	2501	1	600	600

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**600**

Electronic Acknowledgement Receipt	
EFS ID:	42115877
Application Number:	17113851
International Application Number:	
Confirmation Number:	2812
Title of Invention:	BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY
First Named Inventor/Applicant Name:	Alireza Babaei
Customer Number:	148908
Filer:	Alireza Babaei
Filer Authorized By:	
Attorney Docket Number:	2019-006Ut
Receipt Date:	08-MAR-2021
Filing Date:	07-DEC-2020
Time Stamp:	14:51:14
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$600
RAM confirmation Number	E202138E52293441
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	2019-006Ut_IssueFee.pdf	91296 e75fb3f737059c8b19bebf87355a3ebd0bf0ab3a	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30150 2aaf68c0c4b25ef415195164ae9fcd9b9b091448	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	121446		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

148908 7590 03/04/2021
ALIREZA BABAEI
4525 Gilbertson Road
Fairfax, VA 22032

EXAMINER
SMITH, MARCUS

ART UNIT	PAPER NUMBER
2419	

DATE MAILED: 03/04/2021

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/113,851	12/07/2020	Alireza Babaei	2019-006UT	2812

TITLE OF INVENTION: BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$600	$0.00	$0.00	$600	06/04/2021

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

148908 7590 03/04/2021
ALIREZA BABAEI
4525 Gilbertson Road
Fairfax, VA 22032

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/113,851	12/07/2020	Alireza Babaei	2019-006UT	2812

TITLE OF INVENTION: BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$600	$0.00	$0.00	$600	06/04/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
SMITH, MARCUS	2419	370-329000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1_____
2_____
3_____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑Issue Fee ❑Publication Fee (if required) ❑Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/113,851	12/07/2020	Alireza Babaei	2019-006UT	2812

148908 7590 03/04/2021
ALIREZA BABAEI
4525 Gilbertson Road
Fairfax, VA 22032

EXAMINER
SMITH, MARCUS

ART UNIT	PAPER NUMBER
2419	

DATE MAILED: 03/04/2021

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

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The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 17/113,851	Applicant(s) Babaei, Alireza	
	Examiner MARCUS R SMITH	Art Unit 2419	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to amendment filed on 2/22/2021.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1-9 and 11-20 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information , please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/MARCUS SMITH/
Primary Examiner, Art Unit 2419

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/113,851	Babaei, Alireza
	Examiner	**Art Unit**
	MARCUS R SMITH	2419

CPC - Searched*		
Symbol	**Date**	**Examiner**
H04W74/08-0891	01/26/2021 (updated 3/1/2021)	MS
H04L5/001,0091-0098	01/26/2021 (updated 3/1/2021)	MS
H04W72/04-10	01/26/2021 (updated 3/1/2021)	MS

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**
inventor name search in EAST	01/26/2021 (updated 3/1/2021)	MS
(LBT) same (primary or second$4) same (carrier or cell or ?cell) and ($2LBT) same (Direction$4 or BWP or beam or beamform4$)	01/26/2021	MS
($2LBT) same (primary or second$4) with (carrier or cell or ?cell) and LBT with (fail$4 or fault$4 or recovery)	01/26/2021	MS
($LBT same (random acces or PRACH or RACH) and (BWP or bandwidth part) and (beam with fail$4 with recovery))	03/01/2021	MS

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/113,851	Babaei, Alireza
	Examiner	**Art Unit**
	MARCUS R SMITH	2419

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
	see search history printout	03/01/2021	MS

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/113,851	Babaei, Alireza
	Examiner	**Art Unit**
	MARCUS R SMITH	2419

CPC						
Symbol					**Type**	**Version**
H04B	/	7	/	088	F	2013-01-01
H04W	/	76	/	19	I	2018-02-01
H04W	/	52	/	36	I	2013-01-01
H04W	/	80	/	02	I	2013-01-01
H04W	/	74	/	0816	I	2013-01-01

CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 19	
/MARCUS SMITH/ Primary Examiner, Art Unit 2419 (Primary Examiner)	01 March 2021 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 34

U.S. Patent and Trademark Office

Part of Paper No.: 20210301

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/113,851	Babaei, Alireza
	Examiner	**Art Unit**
	MARCUS R SMITH	2419

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H04B7/08	/	7	/	08
H04W76/19	/	76	/	19
H04W74/08	/	74	/	08

NON-CLAIMED				
H04W52/36	/	52	/	36
H04W80/02	/	80	/	02

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 19	
/MARCUS SMITH/ Primary Examiner, Art Unit 2419 (Primary Examiner)	01 March 2021 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 34

U.S. Patent and Trademark Office

Part of Paper No.: 20210301

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/113,851	Babaei, Alireza
	Examiner	**Art Unit**
	MARCUS R SMITH	2419

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1		10	18	19										
2	2	10	11	19	20										
3	3	11	12												
4	4	12	13												
5	5	13	14												
6	6	14	15												
7	7	15	16												
8	8	16	17												
9	9	17	18												

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 19	
/MARCUS SMITH/ Primary Examiner, Art Unit 2419 (Primary Examiner)	01 March 2021 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 34

U.S. Patent and Trademark Office Part of Paper No.: 20210301

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S77	182	(LBT) same (primary or second$4) same (carrier or cell or ?cell) and ($2LBT) same (BWP)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 12:17
S78	37	(beam with fail$4 with recovery) same $LBT same (random acces or PRACH or RACH)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 12:18
S80	54	(beam with fail$4 with recovery) same (random acces or PRACH or RACH) and S79	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 12:31
S79	174	$LBT same (random acces or PRACH or RACH) and $LBT same (BWP or bandwidth part)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 12:31
S81	0	($LBT same (random acces or PRACH or RACH) and $LBT same (BWP or bandwidth part) and (beam with fail$4 with recovery) same (random acces or PRACH or RACH)).clm.	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 13:27
L2	0	($LBT same (random acces or PRACH or RACH) same (BWP or bandwidth part) and (beam with fail$4 with recovery) same (random acces or PRACH or RACH)).clm.	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 14:00
L1	0	($LBT same (random acces or PRACH or RACH) and (BWP or bandwidth part) and (beam with fail$4 with recovery) same (random acces or PRACH or RACH)).clm.	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 14:00
L4	0	($LBT same (random acces or PRACH or RACH) and (BWP or bandwidth part) and (beam with fail$4 with recovery)).clm.	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 14:01
L11	27	(H04W74/08$.cpc.) and (H04W72/04$.cpc. or H04L5/001,0098.cpc.) and (LBT) with BWP and (beam with fail$4 with recovery) same (random acces or PRACH or RACH)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 14:25
L10	46	(L7 or L8 or L9) and (H04W7$) and (beam with fail$4 with recovery) same (random acces or PRACH or RACH)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 14:25
L9	502	($2LBT) same (primary or second$4) with (carrier or cell or ?cell) and LBT with (fail$4 or fault$4 or recovery)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 14:25

L8	273	($2LBT) same (primary or second$4) with (carrier or cell or ?cell) same (fail$4 or fault$4 or recovery)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 14:25
L7	368	($2LBT) same (primary or second$4) same (carrier or cell or ?cell) same (fail$4 or fault$4 or recovery)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 14:25
L12	61	(LBT) same (primary or second$4) same (carrier or cell or ?cell) and ($2LBT) same (BWP) and (beam with fail$4 with recovery) same (random acces or PRACH or RACH)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 14:26
L13	23	(US-20210022179-$ or US-20210007101-$ or US-20200404699-$ or US-20200404586-$ or US-20200351940-$ or US-20200336921-$ or US-20190014596-$ or US-20200322989-$ or US-20200280945-$ or US-20200275484-$ or US-20170099667-$ or US-20200221495-$ or US-20170231011-$ or US-20200187253-$ or US-20200146063-$ or US-20200107364-$ or US-20170006640-$ or US-20190132760-$ or US-20180279386-$ or US-20190200248-$ or US-20200337083-$ or US-20200037359-$ or US-20200413356-$).did.	US-PGPUB	ADJ	ON	2021/03/01 14:27
L18	13	"L17" AND ((H04W74/0808 OR H04W16/14 OR H04W72/0453 OR H04W74/006 OR H04W24/08 OR H04W72/042 OR H04W72/0446 OR H04W56/0015 OR H04W72/046 OR H04W72/14 OR H04W74/08 OR H04W24/02 OR H04W24/10 OR H04W48/12 OR H04W56/001 OR H04W72/1268 OR H04W74/04 OR H04W74/0816 OR H04W74/0833 OR H04W16/28 OR H04W24/00 OR H04W24/04 OR H04W28/26 OR H04W36/0058 OR H04W36/0069 OR H04W36/00835 OR H04W36/06 OR H04W36/305 OR H04W36/36 OR H04W48/16 OR H04W52/0206 OR H04W52/0216 OR H04W68/005 OR H04W72/005 OR H04W72/02 OR H04W72/0406 OR H04W72/044 OR H04W72/0493 OR H04W72/08 OR H04W72/085 OR H04W72/12 OR H04W72/1263 OR H04W72/1284 OR H04W72/1289 OR H04W72/1294 OR H04W74/002 OR H04W74/004 OR H04W74/008 OR H04W74/02 OR H04W74/0841 OR H04W74/0875 OR	US-PGPUB	ADJ	ON	2021/03/01 14:28

		H04W74/0891 OR H04W76/11 OR H04W76/27 OR H04W88/06 OR H04W92/18 OR H04L5/001 OR H04L5/0053 OR H04L27/0006 OR H04L1/1812 OR H04L1/1819 OR H04L1/1822 OR H04L1/1887 OR H04L1/1896 OR H04L27/2602 OR H04L41/0672 OR H04L41/0816 OR H04L5/0007 OR H04L5/0048 OR H04L5/0092 OR H04B7/0695 OR H04B17/318 OR H04B7/088 OR H04B17/17 OR H04B7/0617).CPC.)				
L17	60	$LBT same (random acces or PRACH or RACH) and (BWP or bandwidth part) and (beam with fail$4 with recovery) same (random acces or PRACH or RACH)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 14:28
L16	131	L15 AND ((H04W74/0808 OR H04W16/14 OR H04W72/0453 OR H04W74/006 OR H04W24/08 OR H04W72/042 OR H04W72/0446 OR H04W56/0015 OR H04W72/046 OR H04W72/14 OR H04W74/08 OR H04W24/02 OR H04W24/10 OR H04W48/12 OR H04W56/001 OR H04W72/1268 OR H04W74/04 OR H04W74/0816 OR H04W74/0833 OR H04W16/28 OR H04W24/00 OR H04W24/04 OR H04W28/26 OR H04W36/0058 OR H04W36/0069 OR H04W36/00835 OR H04W36/06 OR H04W36/305 OR H04W36/36 OR H04W48/16 OR H04W52/0206 OR H04W52/0216 OR H04W68/005 OR H04W72/005 OR H04W72/02 OR H04W72/0406 OR H04W72/044 OR H04W72/0493 OR H04W72/08 OR H04W72/085 OR H04W72/12 OR H04W72/1263 OR H04W72/1284 OR H04W72/1289 OR H04W72/1294 OR H04W74/002 OR H04W74/004 OR H04W74/008 OR H04W74/02 OR H04W74/0841 OR H04W74/0875 OR H04W74/0891 OR H04W76/11 OR H04W76/27 OR H04W88/06 OR H04W92/18 OR H04L5/001 OR H04L5/0053 OR H04L27/0006 OR H04L1/1812 OR H04L1/1819 OR H04L1/1822 OR H04L1/1887 OR H04L1/1896 OR H04L27/2602 OR H04L41/0672 OR H04L41/0816 OR H04L5/0007 OR H04L5/0048 OR H04L5/0092 OR H04B7/0695 OR H04B17/318 OR	US-PGPUB	ADJ	ON	2021/03/01 14:28

		H04B7/088 OR H04B17/17 OR H04B7/0617).CPC.)				
L15	174	$LBT same (random acces or PRACH or RACH) and $LBT same (BWP or bandwidth part)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 14:28
L19	46	L17 AND ((H04W74/0808 OR H04W16/14 OR H04W72/0453 OR H04W74/006 OR H04W24/08 OR H04W72/042 OR H04W72/0446 OR H04W56/0015 OR H04W72/046 OR H04W72/14 OR H04W74/08 OR H04W24/02 OR H04W24/10 OR H04W48/12 OR H04W56/001 OR H04W72/1268 OR H04W74/04 OR H04W74/0816 OR H04W74/0833 OR H04W16/28 OR H04W24/00 OR H04W24/04 OR H04W28/26 OR H04W36/0058 OR H04W36/0069 OR H04W36/00835 OR H04W36/06 OR H04W36/305 OR H04W36/36 OR H04W48/16 OR H04W52/0206 OR H04W52/0216 OR H04W68/005 OR H04W72/005 OR H04W72/02 OR H04W72/0406 OR H04W72/044 OR H04W72/0493 OR H04W72/08 OR H04W72/085 OR H04W72/12 OR H04W72/1263 OR H04W72/1284 OR H04W72/1289 OR H04W72/1294 OR H04W74/002 OR H04W74/004 OR H04W74/008 OR H04W74/02 OR H04W74/0841 OR H04W74/0875 OR H04W74/0891 OR H04W76/11 OR H04W76/27 OR H04W88/06 OR H04W92/18 OR H04L5/001 OR H04L5/0053 OR H04L27/0006 OR H04L1/1812 OR H04L1/1819 OR H04L1/1822 OR H04L1/1887 OR H04L1/1896 OR H04L27/2602 OR H04L41/0672 OR H04L41/0816 OR H04L5/0007 OR H04L5/0048 OR H04L5/0092 OR H04B7/0695 OR H04B17/318 OR H04B7/088 OR H04B17/17 OR H04B7/0617).CPC.)	US-PGPUB	ADJ	ON	2021/03/01 14:29
L22	150	L15 AND ((H04W74/0808 OR H04W16/14 OR H04W72/0453 OR H04W74/006 OR H04W24/08 OR H04W72/042 OR H04W72/0446 OR H04W56/0015 OR H04W72/046 OR H04W72/14 OR H04W74/08 OR H04W24/02 OR H04W24/10 OR H04W48/12 OR H04W56/001 OR H04W72/1268 OR	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 14:30

		H04W74/04 OR H04W74/0816 OR H04W74/0833 OR H04W16/28 OR H04W24/00 OR H04W24/04 OR H04W28/26 OR H04W36/0058 OR H04W36/0069 OR H04W36/00835 OR H04W36/06 OR H04W36/305 OR H04W36/36 OR H04W48/16 OR H04W52/0206 OR H04W52/0216 OR H04W68/005 OR H04W72/005 OR H04W72/02 OR H04W72/0406 OR H04W72/044 OR H04W72/0493 OR H04W72/08 OR H04W72/085 OR H04W72/12 OR H04W72/1263 OR H04W72/1284 OR H04W72/1289 OR H04W72/1294 OR H04W74/002 OR H04W74/004 OR H04W74/008 OR H04W74/02 OR H04W74/0841 OR H04W74/0875 OR H04W74/0891 OR H04W76/11 OR H04W76/27 OR H04W88/06 OR H04W92/18 OR H04L5/001 OR H04L5/0053 OR H04L27/0006 OR H04L1/1812 OR H04L1/1819 OR H04L1/1822 OR H04L1/1887 OR H04L1/1896 OR H04L27/2602 OR H04L41/0672 OR H04L41/0816 OR H04L5/0007 OR H04L5/0048 OR H04L5/0092 OR H04B7/0695 OR H04B17/318 OR H04B7/088 OR H04B17/17 OR H04B7/0617).CPC.)				
L21	51	L17 AND ((H04W74/0808 OR H04W16/14 OR H04W72/0453 OR H04W74/006 OR H04W24/08 OR H04W72/042 OR H04W72/0446 OR H04W56/0015 OR H04W72/046 OR H04W72/14 OR H04W74/08 OR H04W24/02 OR H04W24/10 OR H04W48/12 OR H04W56/001 OR H04W72/1268 OR H04W74/04 OR H04W74/0816 OR H04W74/0833 OR H04W16/28 OR H04W24/00 OR H04W24/04 OR H04W28/26 OR H04W36/0058 OR H04W36/0069 OR H04W36/00835 OR H04W36/06 OR H04W36/305 OR H04W36/36 OR H04W48/16 OR H04W52/0206 OR H04W52/0216 OR H04W68/005 OR H04W72/005 OR H04W72/02 OR H04W72/0406 OR H04W72/044 OR H04W72/0493 OR H04W72/08 OR H04W72/085 OR H04W72/12 OR H04W72/1263 OR H04W72/1284 OR H04W72/1289 OR	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/03/01 14:30

		H04W72/1294 OR H04W74/002 OR H04W74/004 OR H04W74/008 OR H04W74/02 OR H04W74/0841 OR H04W74/0875 OR H04W74/0891 OR H04W76/11 OR H04W76/27 OR H04W88/06 OR H04W92/18 OR H04L5/001 OR H04L5/0053 OR H04L27/0006 OR H04L1/1812 OR H04L1/1819 OR H04L1/1822 OR H04L1/1887 OR H04L1/1896 OR H04L27/2602 OR H04L41/0672 OR H04L41/0816 OR H04L5/0007 OR H04L5/0048 OR H04L5/0092 OR H04B7/0695 OR H04B17/318 OR H04B7/088 OR H04B17/17 OR H04B7/0617).CPC.)				
L20	165	(I10 or I11 or I12 or I16 or I19)	US-PGPUB	ADJ	ON	2021/03/01 14:30
L23	172	(I10 or I11 or I12 or I16 or I19)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 14:31
L24	69	($LBT same (random acces or PRACH or RACH) and (BWP or bandwidth part) and (beam with fail$4 with recovery))	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 14:44
L25	57	($LBT same (random acces or PRACH or RACH) same (BWP or bandwidth part) and (beam with fail$4 with recovery))	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 14:46
L26	0	17/113851.app.	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 14:48
L28	10	($LBT same (random acces or PRACH or RACH) and (BWP or bandwidth part) and (beam with fail$4 with recovery)) and L27	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/03/01 14:50
L27	511	((("Babaei") near3 ("Alireza"))).INV.	US-PGPUB; USPAT; USOCR	ADJ	ON	2021/03/01 14:50

3/1/2021 2:51:53 PM
C:\Users\msmith2\Documents\EAST\Workspaces\17113851app.wsp

EAST Search History

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L3	0	($LBT same (random acces or PRACH or RACH) same (BWP or bandwidth part) and (beam with fail$4 with recovery) same (random acces or PRACH or RACH)).clm.	US-PGPUB; USPAT	ADJ	ON	2021/03/01 14:00
L5	0	($LBT same (random acces or PRACH or RACH) and (BWP or bandwidth part) and (beam with fail$4 with recovery)).clm.	US-PGPUB; USPAT	ADJ	ON	2021/03/01 14:01
L6	0	($LBT same (random acces or PRACH or RACH) same (BWP or bandwidth part) and (beam with fail$4 with recovery)).clm.	US-PGPUB; USPAT	ADJ	ON	2021/03/01 14:01
L14	2	"Term Removed"	US-PGPUB	ADJ	ON	2021/03/01 14:27
S82	0	((beam with fail$4 with recovery) same $LBT same (random acces or PRACH or RACH) same (BWP or bandwidth part)).clm.	US-PGPUB; USPAT	ADJ	ON	2021/03/01 12:21
S83	0	((beam with fail$4 with recovery) same $LBT same (random acces or PRACH or RACH) and $LBT same (BWP or bandwidth part)).clm.	US-PGPUB; USPAT	ADJ	ON	2021/03/01 12:21
S84	6	($LBT same (random acces or PRACH or RACH) and $LBT same (BWP or bandwidth part)).clm.	US-PGPUB; USPAT	ADJ	ON	2021/03/01 12:21
S85	0	($LBT same (random acces or PRACH or RACH) and $LBT same (BWP or bandwidth part) and (beam with fail$4 with recovery) same (random acces or PRACH or RACH)).clm.	US-PGPUB; USPAT	ADJ	ON	2021/03/01 13:27

3/1/2021 2:52:05 PM
C:\Users\msmith2\Documents\EAST\Workspaces\17113851app.wsp

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	:	17/113,851	Filed	:	12/07/2020
Confirmation No.:		2812	Art Unit	:	2419
Docket No.	:	2019-006Ut	Examiner	:	Marcus Smith
First Inventor	:	Alireza Babaei	Customer No.	:	148908

Commissioner for Patents
P. O. Box 1450
Alexandria VA 22313-1450

AMENDMENT AND REPLY

Sir/Madam:

In response to the Office Action dated January 28, 2021 (hereinafter, "Office Action"), please consider the Amendment and Reply below.

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks begin on page 6 of this paper.

Electronic Acknowledgement Receipt

EFS ID:	41986097
Application Number:	17113851
International Application Number:	
Confirmation Number:	2812
Title of Invention:	BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY
First Named Inventor/Applicant Name:	Alireza Babaei
Customer Number:	148908
Filer:	Alireza Babaei
Filer Authorized By:	
Attorney Docket Number:	2019-006Ut
Receipt Date:	22-FEB-2021
Filing Date:	07-DEC-2020
Time Stamp:	16:07:11
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2019-006Ut_2021-02-22_ResponseToNFOA.pdf	49472 9c1d0037847bd7d4be3909ab54cc182794cc871a	yes	8

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Applicant Arguments/Remarks Made in an Amendment	6	8
	Claims	2	5
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
Warnings:			
Information:			
	Total Files Size (in bytes):	49472	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

REMARKS

I. Status of Claims

a. Claims 1-20 are pending in this application.

b. Claim 1 is an independent claim.

c. Claims 1-2, 6-8 and 11-12 are currently amended.

d. Claim 10 is cancelled.

Applicant thanks the Examiner for the thoughtful Office Action. Reconsideration and allowance are respectfully requested.

II. Statement of Substance of Interview

The Applicant thanks Examiner Smith for the courtesy of a telephonic interview (hereinafter "Interview") with Inventor and Applicant's representative Dr. Alireza Babaei on February 17, 2021. Prior to the Interview, the Applicant provided an Interview Agenda comprising a draft amendment to independent claim 1. During the interview, the Applicant discussed differences between the independent claim 1, as per the draft amendment, and the cited references. No agreement was reached.

The Office is invited to contact the undersigned should any further clarification or amendment be helpful in advancing prosecution.

III. Allowable Claims

Claims 10-12 are objected to as being dependent upon a rejected base claim (Office Action, page 10). The Applicant thanks the Office for the identification of allowable subject matter.

IV. Rejections under 35 U.S.C. § 103

Claims 1-9 and 13-20 are rejected under 35 U.S.C. § 103 as allegedly being unpatentable over Jang et al. (US 2020/0314903) in view of Basu Mallick et al. (US 2019/0200248). The Applicant respectfully traverses.

However, solely in the interest of advancing the prosecution, Applicant has amended independent claim 1 to recite subject matter of claim 10 which is deemed allowable by the Examiner.

For at least the above reasons, independent claim 1 is patentable over the cited art. Claims 2-9 and 13-20 are further patentable over the cited art for at least the same reasons as the independent claim 1, from which they depend, and further in view of their own features. Accordingly, Applicant respectfully requests the rejection of claims 1-9 and 13-20 under 35 U.S.C. § 103 be reconsidered and withdrawn.

V. Claim Objections

Claims 10-12 stand objected as being dependent upon a rejected base claim but are otherwise allowable. The objections are respectfully traversed. As noted above, claim 10 has been cancelled and its allowable subject matter has been put into claim 1. Further, claims 11-12 are dependent upon independent claim 1 which is patentable for at least the reasons stated above. Accordingly, Applicant respectfully requests the claim objections to be reconsidered and withdrawn.

VI. Conclusion

Applicant is of the belief that all the pending issues have been addressed. Nevertheless, the absence of a reply to a specific rejection, issue or comment does not signify agreement with or concession of that rejection, issue or comment. Nothing in this reply should be construed as an intent to concede any issue with regard to any claim, except as specifically stated in this reply. Finally, the amendment of any claim does not necessarily signify concession of unpatentability of the claim prior to its amendment.

Prompt and favorable consideration of this Amendment and Reply is respectfully

requested.

Respectfully submitted,

/Alireza Babaei/

Alireza Babaei

Registration No. 75,833

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) A method comprising:

receiving, by a wireless device, one or more messages comprising:

first configuration parameters, for beam failure recovery, comprising first random access parameters; ~~and~~

second configuration parameters for listen-before-talk (LBT) failure recovery; and

second random access parameters;

initiating, based on the first configuration parameters and in response to detecting a beam failure on a primary cell, a first random access process on a first bandwidth part (BWP) of the primary cell for beam failure recovery based on the first random access parameters;

triggering, based on the second configuration parameters, consistent LBT failure for the primary cell;

stopping the first random access process, for the beam failure recovery, based on the triggering the consistent LBT failure;

switching from the first BWP of the primary cell to a second BWP of the primary cell as an active BWP of the primary cell; and

initiating a second random access process on the second BWP of the primary cell for consistent LBT failure recovery and based on the second random access parameters.

2. (Currently Amended) The method of claim 1, wherein the second random access process, ~~is~~ for consistent LBT failure recovery, is one of a two-step random access process and a four-step random access process.

3. (Original) The method of claim 2, further comprising initiating a third random access process, for the beam failure recovery, after the second random access process is successfully completed.

4. (Original) The method of claim 2, wherein the second random access process comprises transmitting a transport block comprising an LBT failure medium access control (MAC) control element (CE).

5. (Original) The method of claim 4, wherein:

the transmitting the transport block is based on a logical channel prioritization procedure; and

a first priority associated with the LBT failure MAC CE is higher than a second priority associated with data from any logical channel except uplink common control channel (UL-CCCH) logical channel.

6. (Currently Amended) The method of claim 1, wherein the ~~second~~ first random access process, ~~is~~ for the beam failure recovery, is one of a two-step random access process and a four-step random access process.

7. (Currently Amended) The method of claim 6, further comprising initiating a third random access process for ~~consistent LBT~~ beam failure recovery after the second random access process is successfully completed.

8. (Currently Amended) The method of claim ~~6~~7, wherein the ~~second~~ third random access process comprises transmitting a transport block comprising a beam failure recovery medium access control (MAC) control element (CE).

9. (Original) The method of claim 8, wherein:

the transmitting the transport block is based on a logical channel prioritization procedure; and

a first priority associated with the beam failure recovery MAC CE is higher than a second priority associated with data from any logical channel except uplink common control channel (UL-CCCH) logical channel.

10. (Cancelled)

11. (Currently Amended) The method of claim [[10]]1, wherein the first random access parameters indicate random access resources for a beam failure recovery random access process.

12. (Currently Amended) The method of claim [[10]]1, wherein the first random access parameters indicate:

a random access response window for beam failure recovery;

a first number of preamble transmissions before declaring a random access failure for beam failure recovery;

a power ramping step for a beam failure recovery random access process; and

a configuration index for beam failure recovery.

13. (Original) The method of claim 1, wherein the first configuration parameters for beam failure recovery comprise an identifier of a search space for monitoring a control channel in a beam failure recovery random access process.

14. (Original) The method of claim 1, wherein:

the first configuration parameters comprise a first parameter indicating a first number of beam failure instances that triggers beam failure recovery; and

the detecting the beam failure is based on a beam failure instance indication counter reaching the first number.

15. (Original) The method of claim 14, wherein the detecting the beam failure comprises incrementing the beam failure instance indication counter by one based on a beam failure indication.

16. (Original) The method of claim 14, wherein the detecting the beam failure comprises setting the beam failure instance indication counter to zero based on a beam failure detection timer expiring.

17. (Original) The method of claim 1, wherein:

    the second configuration parameters comprise a first parameter indicating a first number of LBT failure instances that triggers LBT failure recovery; and

    the triggering the consistent LBT failure is based on an LBT failure indication counter reaching the first number.

18. (Original) The method of claim 17, wherein the triggering the consistent LBT failure comprises incrementing the LBT failure indication counter by one based on an LBT failure indication.

19. (Original) The method of claim 17, wherein the triggering the consistent LBT failure comprises setting the LBT failure indication counter to zero based on an LBT failure detection timer expiring.

20. (Original) The method of claim 1, wherein:

    the second BWP of the primary cell is configured with random access occasions; and

    the switching from the first BWP of the primary cell to a second BWP of the primary cell is based on the second BWP of the primary cell being configured with the random access occasions.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/113,851	Filing Date 12/07/2020	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $480 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

AMENDMENT		(Column 1)		(Column 2)	(Column 3)			
	02/22/2021	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 19	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 1	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

AMENDMENT		(Column 1)		(Column 2)	(Column 3)			
		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/SHERRY A DAVIS/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/113,851	12/07/2020	Alireza Babaei	2019-006Ut	2812

148908 7590 02/22/2021
ALIREZA BABAEI
4525 Gilbertson Road
Fairfax, VA 22032

EXAMINER
SMITH, MARCUS

ART UNIT	PAPER NUMBER
2419	

MAIL DATE	DELIVERY MODE
02/22/2021	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

Applicant-Initiated Interview Summary	**Application No.** 17/113,851	**Applicant(s)** Babaei, Alireza		
	Examiner MARCUS R SMITH	**Art Unit** 2419	**AIA (First Inventor to File) Status** Yes	**Page** 1 of 1

All Participants (applicant, applicants representative, PTO personnel)	**Title**	**Type**
MARCUS R SMITH	Primary Examiner	Telephonic
ALIREZA BABAEI	Attorney of Record	

Date of Interview: 17 February 2021

Issues Discussed:

35 U.S.C. 103

The examiner and applicant representative/inventor discuss the claimed invention and cited art. No agreement was reached at this time.

Proposed Amendment(s)

The examiner stated the proposed amendment presented will not overcome the cited art at this time.

/MARCUS SMITH/ Primary Examiner, Art Unit 2419	

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

FOR DISCUSSION ONLY- NOT FOR ENTRY

Proposed Agenda for Interview

Application No. : 17/113,851
Docket No. : 2019-006Ut

Interview Plan:

Telephonic interview is scheduled on **Wednesday, February 17, 2021 at 10:30 AM EST**. The Applicant will contact the Examiner at the Examiner's office telephone number at the appointed time.

Participants:

1. Examiner: Marcus Smith (o: 571-270-1096)
2. Inventor and Applicant's representative: Dr. Alireza Babaei, Reg. No. 75,833 (o: 703-798-0675)

Draft Claim:

The draft claim below is provided as an example for discussion purposes.

1. A method comprising:

receiving, by a wireless device, one or more messages comprising:

first configuration parameters for beam failure recovery; and

second configuration parameters for listen-before-talk (LBT) failure recovery;

initiating, based on the first configuration parameters and in response to detecting a beam failure on a primary cell, a first random access process on a first bandwidth part (BWP) of the primary cell for beam failure recovery;

triggering, based on the second configuration parameters, consistent LBT failure for the primary cell;

stopping**, by the wireless device,** the **ongoing** first random access process**[[,]]** for the beam failure recovery, based on the triggering the consistent LBT failure;

switching from the first BWP of the primary cell to a second BWP of the primary cell as an active BWP of the primary cell; and

initiating a second random access process on the second BWP of the primary cell.

Remarks:

Claim 1 is rejected under 35 U.S.C. § 103 as being unpatentable over Jang et al. (US 2020/0314903) in view of Basu Mallick et al. (US 2019/0200248). The applicant intends to discuss the differences between independent claim 1, as per the draft amendment, and the combination of cited art.

UNITED STATES PATENT AND TRADEMARK OFFICE

USPTO Automated Interview Request (AIR)

Feb 8 2021

This paper requesting to schedule and/or conduct an interview is appropriate because:

This submission is requested to be accepted as an authorization for this interview to communicate via the internet. Recognizing that Internet communications are not secure, I hereby authorize the USPTO to communicate with the undersigned concerning scheduling of the interview via video conference, instant messaging, or electronic mail, and to conduct the interview in accordance with office practice including video conferencing.

Name(s):
Alireza Babaei

S-signature:
/Alireza Babaei/

Registration Number:
75833

U.S. Application Number:
17113851

Confirmation Number:
2812

E-mail Address:
ar.babaei@gmail.com

Phone Number:
+1 7037980675

Proposed Time of Interview:
2-17-2021 11:00 AM ET

Alternative Proposed Time(s) of Interview:
2-20-2021 11:00 AM ET

Alternative Proposed Time(s) of Interview:
2-20-2021 2:00 PM ET

Prefered Interview Type:
Telephonic

I am the applicant or applicant's representative for this application.

Topic for Discussion:
2019-006Ut | To discuss rejections. Please contact me at ar.babaei@gmail.com to confirm the interview.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/113,851	12/07/2020	Alireza Babaei	2019-006Ut	2812

148908 7590 01/28/2021
ALIREZA BABAEI
4525 Gilbertson Road
Fairfax, VA 22032

EXAMINER
SMITH, MARCUS

ART UNIT	PAPER NUMBER
2419	

MAIL DATE	DELIVERY MODE
01/28/2021	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No. 17/113,851	Applicant(s) Babaei, Alireza	
	Examiner MARCUS R SMITH	Art Unit 2419	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 07 December 2020.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-20 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-9 and 13-20 is/are rejected.

8) ☑ Claim(s) 10-12 is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 07 December 2020 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

3. The factual inquiries for establishing a background for determining obviousness under 35 U.S.C. 103 are summarized as follows:

1. Determining the scope and contents of the prior art.

2. Ascertaining the differences between the prior art and the claims at issue.

3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. Claims 1-9, and 13-20 are rejected under 35 U.S.C. 103 as being unpatentable over Jang et al. (US 2020/0314903) in view Basu Mallick et al. (US 2019/0200248).

With regard to claim 1, Jang teaches (see figure 3 and figure 8A): A method comprising:

receiving, by a wireless device, one or more messages (paragraphs 76 and 87)comprising:

second configuration parameters for listen-before-talk (LBT) failure recovery (see step 7-11 in figure 7 and step 8a-03 in figure 8A: paragraphs 76 and 87);

initiating, based on the first configuration parameters and in response to detecting a beam failure on a primary cell (paragraphs 53 and 99: it may also be informed that the terminal performs random access due to a transmission failure caused by deviation of communication [redacted].) , a first random access process on a first bandwidth part (BWP) of the primary cell for beam failure recovery (paragraphs 53 and 99: the terminal 3-03 is located in [redacted] #1 3-13 and performs random access, but after failure, when the random access preamble is transmitted again, a scenario is possible in which the terminal 3-03 is located in [redacted] #3 3-17 and transmits the dedicated preamble.) ;

triggering, based on the second configuration parameters, consistent LBT failure for the primary cell (UL LBT failure: paragraphs 79, 84, 92, and 96);

stopping the first random access process, for the beam failure recovery, based on the triggering the consistent LBT failure (UL problem recognized: paragraphs 80,83-84, 94 and 99.

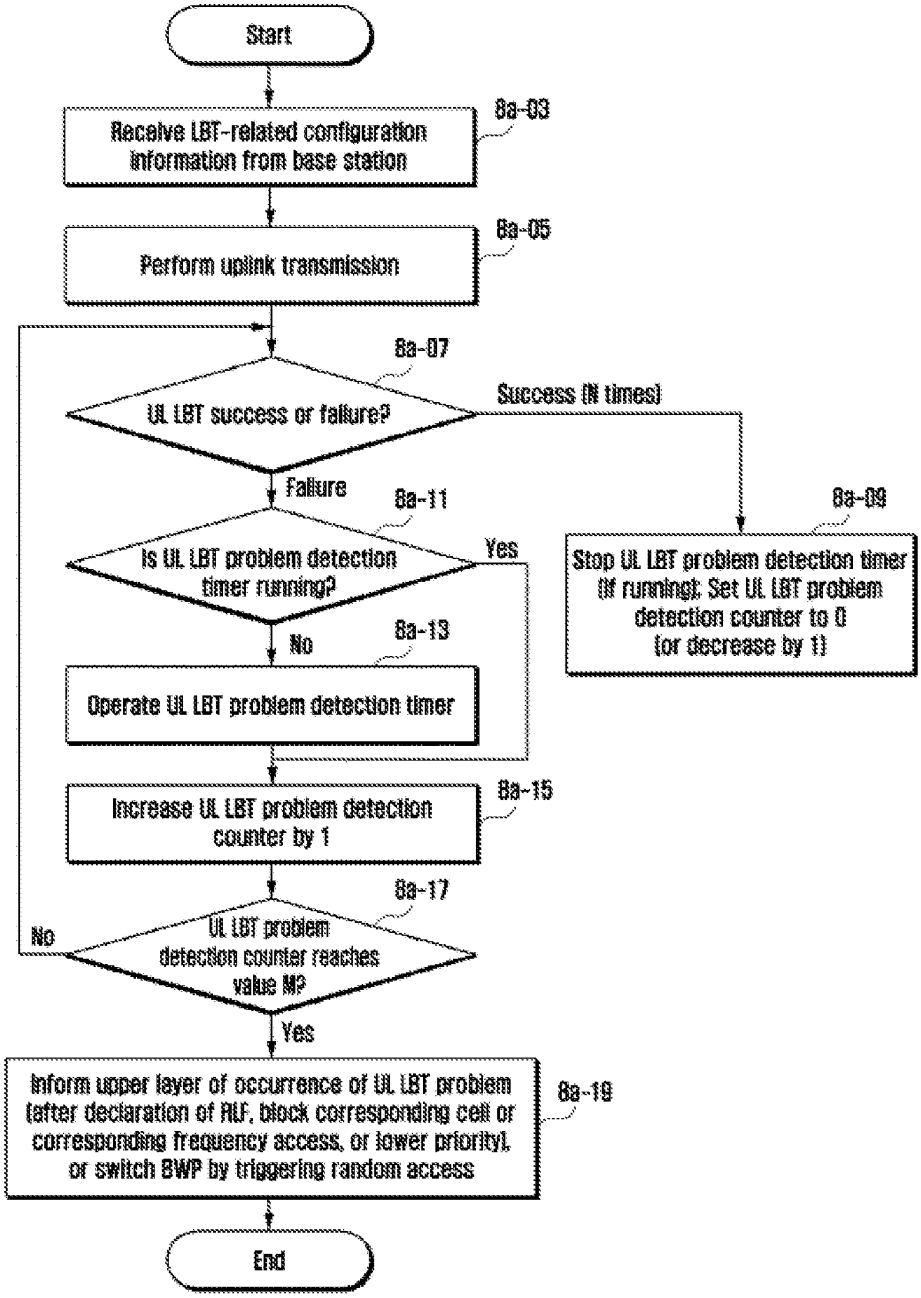
Accordingly, the base station may know that the terminal has performed random access due to an uplink LBT [redacted] and

may further perform operations, such as allowing handover to another base station or [redacted] for operation of **stopping use** even for other terminals with respect to the [redacted] in which the terminal used to operate.);

switching from the first BWP of the primary cell to a second BWP of the primary cell as an active BWP of the primary cell (step 8a-19 in figure 8: paragraphs 94, 97, and 99); and

initiating a second random access process on the second BWP of the primary cell (paragraphs 97-99 and 113: The controller 9-40 may detect a UL LBT program, e.g., by using the described methods, and trigger [redacted] or indicate an RRC layer to perform an RLF operation.).

FIG. 8A


Start
Receive LBT-related configuration information from base station
8a-03
Perform uplink transmission
8a-05
8a-07
UL LBT success or failure?
Success (N times)
Failure
8a-11
Is UL LBT problem detection timer running?
Yes
No
8a-13
Operate UL LBT problem detection timer
8a-09
Stop UL LBT problem detection timer (if running). Set UL LBT problem detection counter to 0 (or decrease by 1)
Increase UL LBT problem detection counter by 1
8a-15
8a-17
UL LBT problem detection counter reaches value M?
No
Yes
Inform upper layer of occurrence of UL LBT problem (after declaration of RLF, block corresponding cell or corresponding frequency access, or lower priority), or switch BWP by triggering random access
8a-19
End

Jang discloses the LBT uplink transmission in 8a-05 is for performing random access (paragraph 88) and that transmission failure of random access is based on deviation of communication beams (paragraph 99). Jang does not discloses the LBT related configuration is associated with beam failure and beam recovery. Thus, Jang fails to disclose first configuration parameters for beam failure recovery.

Basu disclose a similar process of transmitting random access messages based on beam failure (see figure 5) similar to the system of Jang. However, Basu also discloses that the transceiver receives beam revival configuration information for beam failure recovery (paragraphs 63-65).

Description of Disclosure - DETX (59):

[0064] In some embodiments, the transceiver 325 ***receives a configuration for the*** [redacted] ***revival procedure. Here, the configuration for the*** [redacted] ***revival procedure indicates at least one of: a first number of consecutive*** [redacted] ***revival instances, a RSRP threshold value, and a BLER threshold value.*** In one embodiment, the [redacted] revival procedure is determined to be successful for an active [redacted] of the first set in response to a RSRP measurement value of the active [redacted] being above the configured RSRP threshold value for the first number of consecutive [redacted] revival instances.

[0065] In another embodiment, the [redacted] revival procedure is determined to be successful for an active [redacted] of the first set in response to a hypothetical BLER of the active [redacted] being above the configured BLER threshold value for the first number of consecutive [redacted] revival instances. In certain embodiments, the [redacted] revival procedure is determined to be successful for an active [redacted] of the first set in response to a PDCCH being successfully decoded, where a DM-RS of the PDCCH is quasi-co-located with a [redacted] failure detection reference signal of the active [redacted].

Since LBT failure is based on deviation beam (beam failure), it would have been obvious to one having ordinary skill in the art at the time before the effective filing date of the claim invention to received beam revival configuration to perform beam recovery as taught by Basu in the LBT failure method of Jang in order to improve connection response times (Basu: paragraph 113).

With regard to claim 2, Jang teaches: wherein the second random access process is for consistent LBT failure recovery (paragraphs 96-99).

With regard to claim 3, Jang teaches: further comprising initiating a third random access process, for the beam failure recovery, after the second random access process is successfully completed (paragraphs 96-99).

With regard to claim 4, Jang teaches: wherein the second random access process comprises transmitting a transport block comprising an LBT failure medium access control (MAC) control element (CE) (paragraphs 98-99)

With regard to claim 5, Jang teaches: wherein:the transmitting the transport block is based on a logical channel prioritization procedure; and afirst priority associated with the LBT failure MAC CE is higher than a second priority associated with data from any logical channel except uplink common control channel (UL-CCCH) logical channel (paragraphs 78, 89, 98-99).

With regard to claim 6, Jang teaches: wherein the second random access process is for the beam failure recovery (paragraph 99).

With regard to claim 7, Jang teaches: further comprising initiating a third random access process for consistent LBT failure recovery after the second random access process is successfully completed (paragraphs 96-99).

With regard to claim 8, Jang teaches: wherein the second random access process comprises transmitting a transport block comprising a beam failure recovery medium access control (MAC) control element (CE) (paragraphs 98-99).

With regard to claim 9, Jang teaches: wherein: the transmitting the transport block is based on a logical channel prioritization procedure; and a first priority associated with the beam failure recovery MAC CE is higher than a second priority associated with data from any logical channel except uplink common control channel (UL-CCCH) logical channel (paragraphs 78, 89, 98-99).

With regard to claim 13, Basu teaches: wherein the first configuration parameters for beam failure recovery comprise an identifier of a search space for monitoring a control channel in a beam failure recovery random access process (paragraph 37: coresets). same motivation as claim 1.

With regard to claim 14, Basu also teaches: wherein: the first configuration parameters comprise a first parameter indicating a first number of beam failure instances that triggers beam failure recovery (paragraphs 64-65); and the detecting the beam failure is based on a beam failure instance indication counter reaching the first number (paragraphs 92-94) same motivation as claim 1.

With regard to claim 15, Basu teaches: wherein the detecting the beam failure comprises incrementing the beam failure instance indication counter by one based on a beam failure indication (paragraphs 96 and 117:

Unsuccessful recovery from beam failure is declared upon reaching the configured maximum number of BFRR transmission, or upon expiry of the beam failure recovery [redacted] e.g., when the beam failure recovery [redacted] starts upon beam failure detection.).

With regard to claim 16, Jang teaches: wherein the detecting the beam failure comprises setting the beam failure instance indication counter to zero based on a beam failure detection timer expiring (paragraphs 56 and 96).

With regard to claim 17, Jang teaches: wherein :the second configuration parameters comprise a first parameter indicating a first number of LBT failure instances that triggers LBT failure recovery; and the triggering the consistent LBT failure is based on an LBT failure indication counter reaching the first number (paragraphs 79-80

0079] If the terminal 1-01 is unable to perform transmission due to an LBT failure when performing uplink transmission (i.e., if a signal is detected due to transmission of another device in the channel, and therefore transmission cannot be performed), in step 7-15, the terminal 7-01 determines whether a predetermined timer is running. If the timer is not running, the terminal 7-01 drives the timer. **A length of the timer may be configured according to the RRCReconfiguration or SIB message.**

[0080] In the example of FIG. 7, each time LBT fails in steps 7-17 and 7-19, a predetermined counter is increased, which allows the counter to recognize seriousness of a UL LBT [redacted] while the timer is running, and perfor**m an additional operation when the counter reaches a value configured by the base station 7-03 according to the RRCReconfiguration or SIB message.**).

With regard to claim 18, Jang teaches: wherein the triggering the consistent LBT failure comprises incrementing the LBT failure indication counter by one based on an LBT failure indication (paragraphs 80 and 92).

With regard to claim 19, Jang teaches: wherein the triggering the consistent LBT failure comprises setting the LBT failure indication counter to zero based on an LBT failure detection timer expiring (paragraphs 82 and 91-93).

With regard to claim 20, Jang teaches: wherein: the second BWP of the primary cell is configured with random access occasions; and the switching from the first BWP of the primary cell to a second BWP of the primary cell is based on the second BWP of the primary cell being configured with the random access occasions (paragraphs 97-99).

Allowable Subject Matter

5. Claims 10-12 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Chen et al. (US 2020/0221495: see figure 2)

Jose et al. (US 2020/0154480: see figure 11)

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to MARCUS R SMITH whose telephone number is

(571)270-1096. The examiner can normally be reached on Monday-Friday 9:00 AM - 5:00 PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Hadi Armouche can be reached on (571)270-3618. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

1/26/2021
/MARCUS SMITH/
Primary Examiner, Art Unit 2419

Notice of References Cited	Application/Control No. 17/113,851	Applicant(s)/Patent Under Reexamination Babaei, Alireza	
	Examiner MARCUS R SMITH	Art Unit 2419	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20200314903-A1	10-2020	JANG; Jaehyuk	H04W74/0833	1/1
*	B	US-20190200248-A1	06-2019	Basu Mallick; Prateek	H04B7/0695	1/1
*	C	US-20200221495-A1	07-2020	CHEN; HUNG-CHEN	H04W36/305	1/1
*	D	US-20200154480-A1	05-2020	Jose; Pradeep	H04W74/0825	1/1
	E					
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
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	S					
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NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
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	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/113,851	Babaei, Alireza
	Examiner	**Art Unit**
	MARCUS R SMITH	2419

CPC - Searched*		
Symbol	**Date**	**Examiner**
H04W74/08-0891	01/26/2021	MS
H04L5/001,0091-0098	01/26/2021	MS
H04W72/04-10	01/26/2021	MS

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**
inventor name search in EAST	01/26/2021	MS
(LBT) same (primary or second$4) same (carrier or cell or ?cell) and ($2LBT) same (Direction$4 or BWP or beam or beamform4$)	01/26/2021	MS
($2LBT) same (primary or second$4) with (carrier or cell or ?cell) and LBT with (fail$4 or fault$4 or recovery)	01/26/2021	MS

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/113,851	Babaei, Alireza
	Examiner	**Art Unit**
	MARCUS R SMITH	2419

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17113851
	Filing Date	2020-12-07
	First Named Inventor	Alireza Babaei
	Art Unit	
	Examiner Name	
	Attorney Docket Number	2019-006Ut

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /M.S/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	17113851
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	First Named Inventor	Alireza Babaei
	Art Unit	
	Examiner Name	
	Attorney Docket Number	2019-006Ut

	1	3GPP TS 38.211 V15.7.0 (2019-09); Technical Specification; 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Physical channels and modulation; (Release 15)	
	2	3GPP TS 38.212 V15.7.0 (2019-09); Technical Specification; 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Multiplexing and channel coding; (Release 15)	
	3	3GPP TS 38.213 V15.7.0 (2019-09); Technical Specification; 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Physical layer procedures for control; (Release 15)	
	4	3GPP TS 38.214 V15.7.0 (2019-09); Technical Specification; 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Physical layer procedures for data; (Release 15)	
	5	3GPP TS 38.300 V15.7.0 (2019-09); Technical Specification; 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; NR and NG-RAN Overall Description; Stage 2; (Release 15)	
	6	3GPP TS 38.321 V15.7.0 (2019-09); Technical Specification; 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Medium Access Control (MAC) protocol specification; (Release 15)	
	7	3GPP TS 38.331 V15.7.0 (2019-09); Technical Specification; 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Radio Resource Control (RRC); Protocol specification; (Release 15)	
	8	3GPP RAN WG2 Meeting #107; R2-1909604; Prague, Czech Republic, Aug. 26–30th, 2019 Revision of R2-1906403; Agenda Item: 11.2.1.2; Source: InterDigital; Title: Handling UL LBT Failures in MAC; Document for: Discussion, Decision	
	9	3GPP TSG-RAN WG2 Meeting #107bis; R2-1912095; Chongqing, China, 14th Oct. – 18th Oct 2019; Agenda Item: 6.2.2.2; Source: OPPO; Title: Remaining issues of detecting uplink LBT failure in NR-U; Document for: Discussion, Decision	
	10	3GPP TSG-RAN WG2 Meeting #107bis; R2-1912096; Chongqing, China, 14th Oct. – 18th Oct 2019; Agenda Item: 6.2.2.2; Source: OPPO; Title: Uplink LBT failure recovery for NR-U; Document for: Discussion, Decision	
	11	3GPP TSG-RAN WG2 Meeting #107bis; R2-1912177; Chongqing, China, 14th – 18th Oct, 2019; Source: vivo; Title: Remaining issues of uplink LBT failure; Agenda Item: 6.2.1.2; Document for: Discussion and Decision	

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	Art Unit	
	Examiner Name	
	Attorney Docket Number	2019-006Ut

	12	3GPP TSG-RAN WG2 Meeting #107bis; R2-1912178; Chongqing, China, 14th – 18th Oct, 2019; Source: vivo; Title: Issue on the autonomous BWP switching; Agenda Item: 6.2.1.2; Document for: Discussion and Decision	
	13	3GPP TSG-RAN2#107bis; R2-1912304; Chongqing, China, October 14-18, 2019; Agenda item: 6.2.1.4; Source: Qualcomm Incorporated; Title: Details of the Uplink LBT failure mechanism; Document for: Discussion/Decision	
	14	3GPP TSG-RAN WG2 Meeting #107bis; R2-1912474; Chongqing, China, 14–18 October 2019; Agenda item: 6.2.2.2; Source: Samsung; Title: Recovery of consistent UL LBT failures; Document for: Discussion and Agreement	
	15	3GPP TSG-RAN WG2 Meeting #107bis; R2-1912569; Chongqing, China, 14th-18th October 2019; Source: Panasonic; Title: Handling UL LBT Failures in NR-U; Agenda Item: 6.2.2.2; Document for: Discussion and Decision	
	16	3GPP TSG-RAN WG2 107bis; R2-1912625; Chongqing, China, October 14-18, 2019; Agenda Item: 6.2.1.2; Source: Intel Corporation; Title: Detecting and Handling of UL LBT failures; Document for: Discussion and Decision	
	17	3GPP TSG-RAN WG2 Meeting #107bis; R2-1912684; Chongqing, China, 14th - 18th October 2019; resubmission of R2-1910099; Agenda item: 6.2.2.2; Source: Lenovo, Motorola Mobility; Title: Impact of systematic LBT failure on UL transmission procedure; Document for: Discussion and Decision	
	18	3GPP RAN WG2 Meeting #107bis; R2-1912889; Chongqing, China, Oct. 14–18th, 2019; Revision of R2-1909604; Agenda Item: 6.2.2.2; Source: InterDigital; Title: Handling UL LBT Failures in MAC; Document for: Discussion, Decision	
	19	3GPP TSG-RAN WG2 Meeting 107bis; R2-1913029; Chongqing, China, 14 – 18 Oct., 2019; Agenda Item: 6.2.2.2; Source: Huawei, HiSilicon; Title: UL LBT failure; Document for: Discussion, Decision	
	20	3GPP TSG-RAN WG2 Meeting #107bis; R2-1913260; Chongqing, China, 14th - 18th October 2019; Agenda Item: 6.2.2.2; Souce: MediaTek Inc.; Title: On consistent LBT failures; Document for: Discussion and decision	
	21	3GPP TSG-RAN WG2 Meeting #107bis; R2-1913287; Chongqing, China, 14 – 18 October 2019; Agenda item: 6.2.2.2; Source: Nokia, Nokia Shanghai Bell; Title: Remaining issues on UL LBT; WID/SID: NR_unlic-Core – Release 16; Document for: Discussion and Decision	
	22	3GPP TSG-RAN WG2 Meeting #107bis; R2-1913294; Chongqing, China, 14th – 18th October 2019; Agenda Item: 6.2.2.2; Source: Fujitsu; Title: UE behaviour upon consistent UL LBT failures; Document for: Discussion & Decision	

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	Examiner Name	
	Attorney Docket Number	2019-006Ut

	23	3GPP TSG-RAN WG2 Meeting #107bis; R2-1913649; Chongqing, China, 14th - 18th October 2019; Agenda item: 6.2.2.2; Source: Charter Communications; Title: Remaining Issues on Consistent LBT Failure Detection in NRU; WID/SID: NR-U WID - Release 16; Document for: Discussion and Decision	
	24	3GPP TSG-RAN WG2 Meeting #108; R2-1914367; Reno, USA, Nov 18-22, 2019; Source: vivo; Title: Remaining issues on uplink LBT failure; Agenda Item: 6.2.2.2; Document for: Discussion and Decision	
	25	3GPP TSG-RAN WG2 Meeting #108; R2-1914400; Reno, USA, 18th Nov– 22nd Nov 2019; Agenda Item: 6.2.2.2; Source: OPPO; Title: Remaining issues of consistent UL LBT failure; Document for: Discussion, Decision	
	26	3GPP TSG-RAN WG2 108; R2-1914572; Reno, USA, November 18-22, 2019; Agenda Item: 6.2.2.2; Source: Intel Corporation; Title: Handling of UL LBT failures; Document for: Discussion and Decision	
	27	3GPP TSG RAN WG2 NR #108 Meeting; R2-1914791; Reno, USA, 18 - 22 November, 2019; Agenda Item: 6.2.2.2; Source: ZTE Corporation, Sanechips; Title: LBT failure report on SCell; Document for: Discussion and Decision	
	28	3GPP TSG-RAN WG2 Meeting #108; R2-1915015; Reno, USA, 18 – 22 November 2019; Revision of R2-1912243; Agenda item: 6.2.2.2; Source: Spreadtrum Communications, Huawei, HiSilicon; Title: LBT Failures Handling in Non-Connected State; Document for: Discussion and Decision	
	29	3GPP TSG-RAN WG2 Meeting #108; R2-1915105; Reno, USA, 18th - 22nd November 2019; Agenda item: 6.2.2.2; Source: Lenovo, Motorola Mobility; Title: UE behavior upon consistent LBT failure; Document for: Discussion and Decision	
	30	3GPP TSG-RAN WG2 Meeting 108; R2-1915141; Reno, USA, 18th- 22nd November 2019; Agenda Item: 6.2.2.2; Source: Huawei, HiSilicon; Title: Handling of UL LBT failure; Document for: Discussion, Decision	
	31	3GPP TSG-RAN WG2 Meeting #108; R2-1915177; Reno, USA, 18th Nov – 22nd Nov 2019; Source: Panasonic; Title: Remaining issue on detecting UL LBT Failures; Agenda Item: 6.2.2.2; Document for: Discussion and Decision	
	32	3GPP TSG-RAN WG2 Meeting #108; R2-1915197; Reno, USA, 18th Nov – 22th Nov 2019; Agenda item: 6.2.2.2 Source: CMCC; Title: Details on determining consistent LBT failure of a BWP; Document for: Discussion	
	33	3GPP TSG-RAN WG2 Meeting #108; R2-1915544; Reno, USA, 18th – 22nd November 2019; Revision of R2-1913260; Agenda Item: 6.2.2.2; Source: MediaTek Inc.; Title: Remaining issues on consistent LBT failures; Document for: Discussion and decision	

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	First Named Inventor	Alireza Babaei
	Art Unit	
	Examiner Name	
	Attorney Docket Number	2019-006Ut

	34	3GPP TSG-RAN WG2 Meeting #108; R2-1915765; Reno, NV, USA 18-22 November 2019; Agenda item: 6.2.2.4; Source: Qualcomm Incorporated; Title: Remaining details of UL LBT failure mechanism; Document for: Discussion and Decision	
	35	3GPP TSG-RAN WG2 Meeting #108; R2-1915885; Reno, USA, 18 – 22 November 2019; update of R2-1913287; Agenda item: 6.2.2.2; Source: Nokia, Nokia Shanghai Bell, InterDigital, MediaTek, OPPO; Title: UL LBT failure; Detection; WID/SID: NR_unlic-Core - Release 16; Document for: Discussion and Decision	
	36	3GPP TSG-RAN WG2 Meeting #108; R2-1915886; Reno, USA, 18 – 22 November 2019; Agenda item: 6.2.2.2; Source: Nokia, Nokia Shanghai Bell; Title: UL LBT failure report; WID/SID: LTE_NR_DC_CA_enh-Core - Release 16; Document for: Discussion and Decision	

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/MARCUS SMITH/	Date Considered	01/23/2021

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17113851
	Filing Date	2020-12-07
	First Named Inventor	Alireza Babaei
	Art Unit	
	Examiner Name	
	Attorney Docket Number	2019-006Ut

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Alireza Babaei/	Date (YYYY-MM-DD)	2020-12-11
Name/Print	Alireza Babaei	Registration Number	75833

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	742	(H04W74/08$.cpc.) and (H04W72/04$.cpc. or H04L5/001,0098.cpc.) and (LBT) same (primary or second$4) same (carrier or cell or ?cell)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 10:39
S2	115	(H04W74/08$.cpc.) and (H04W24/$.cpc.) and (LBT) same (primary or second$4) same (carrier or cell or ?cell)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 10:40
S3	581	(H04W74/08$.cpc.) and (H04W72/04$.cpc. or H04L5/001,0098.cpc.) and (LBT) same (primary or second$4) with(carrier or cell or ?cell)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 10:40
S4	6	(H04W74/08$.cpc.) and (H04B7/08$.cpc.) and (LBT) same (primary or second$4) with(carrier or cell or ?cell)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 10:42
S5	34	(H04W74/08$.cpc.) and (H04B7/0$.cpc.) and (LBT) same (primary or second$4) with(carrier or cell or ?cell)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 10:43
S6	3	(H04W74/08$.cpc.) and (H04W76/18-19.cpc.) and (LBT) same (primary or second$4) with(carrier or cell or ?cell)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 10:43
S7	654	(S5 or S2 or S3 or S4 or S6)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 10:44
S8	26	(H04W74/08$.cpc.) and (H04W72/04$.cpc. or H04L5/001,0091-0098.cpc.) and (LBT) same (primary or second$4) same (carrier or cell or ?cell) and ($2LBT) near (Direction$4 or BWP or beam or beamform4$)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 11:09
S9	45	(LBT) same (primary or second$4) same (carrier or cell or ?cell) and ($2LBT) near (Direction$4 or BWP or beam or beamform4$)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 11:09
S10	382	(LBT) same (primary or second$4) same (carrier or cell or ?cell) and ($2LBT) same (Direction$4 or BWP or beam or beamform4$)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 11:09

S11	382	(S8 or S9 or S10)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 11:09
S12	490	((("Babaei") near3 ("Alireza"))).INV.	US-PGPUB; USPAT; USOCR	ADJ	ON	2021/01/23 11:09
S13	346	($2LBT) same (primary or second$4) same (carrier or cell or ?cell) same (fail$4 or fault$4 or recovery)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 11:14
S14	256	($2LBT) same (primary or second$4) with (carrier or cell or ?cell) same (fail$4 or fault$4 or recovery)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 11:14
S15	480	($2LBT) same (primary or second$4) with (carrier or cell or ?cell) and LBT with (fail$4 or fault$4 or recovery)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 11:14
S16	373	(S13 or S14 or S15) and (H04W72/$.cpc.)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 11:15
S17	96	((S13 or S14 or S15) and (H04W74/$.cpc.)) not S16	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 11:15
S18	80	((S13 or S14 or S15)) not (S16 or S17)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 11:21
S19	338	((S13 or S14 or S15)) not S7	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 11:26
S20	194	((S13 or S14 or S15) and (H04W72/$.cpc.)) not S7	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 11:26
S21	0	17/113851.app.	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 12:18
S22	25	(US-20210022179-$ or US-20210007101-$ or US-20200404699-$ or US-20200404586-$ or US-20200351940-$ or US-20200336921-$ or US-20190014596-$ or US-20200322989-$ or	US-PGPUB	ADJ	ON	2021/01/23 12:18

		US-20200314903-$ or US-20200280945-$ or US-20200275484-$ or US-20170099667-$ or US-20200221495-$ or US-20170231011-$ or US-20200187253-$ or US-20200154480-$ or US-20200146063-$ or US-20200107364-$ or US-20170006640-$ or US-20190132760-$ or US-20180279386-$ or US-20190200248-$ or US-20200337083-$ or US-20200037359-$ or US-20200413356-$).did.				
S23	21	S22 and (LBT or beam) with (fail$4 or fault$4 or recovery)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 12:25
S24	1	(US-20200322989-$).did.	US-PGPUB	ADJ	ON	2021/01/23 12:58
S25	1	(US-20200314903-$).did.	US-PGPUB	ADJ	ON	2021/01/23 12:59
S26	1	(US-20200221495-$).did.	US-PGPUB	ADJ	ON	2021/01/23 13:00
S27	1	(US-20200154480-$).did.	US-PGPUB	ADJ	ON	2021/01/23 13:01
S28	1	(US-20190200248-$).did.	US-PGPUB	ADJ	ON	2021/01/23 13:02
S29	5	(S24 or S25 or S26 or S27 or S28) and LBT	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 13:21
S30	4	(S24 or S25 or S26 or S27 or S28) and bWP	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 13:21
S31	4	(S24 or S25 or S26 or S27 or S28) and (RLF or radio link fail$4 or beam)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 13:22
S32	5	(S24 or S25 or S26 or S27 or S28)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 13:25
S33	5	(S24 or S25 or S26 or S27 or S28) and (RRC or configurat$4 or SIB$3 or DCI or UCI or MIB)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 13:28
S34	2	(S24 or S25 or S26 or S27 or S28) and (beam)	US-PGPUB; USPAT; FPRS	ADJ	ON	2021/01/23 13:33

1/26/2021 3:34:31 PM
C:\Users\msmith2\Documents\EAST\Workspaces\17113851app.wsp

Bibliographic Data

Application No: 17/113,851

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /MARCUS SMITH/ (Examiner's Signature) | Initials

Title: BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/07/2020 **RULE**	370	2419	2019-006Ut

APPLICANTS

INVENTORS

Alireza Babaei, Fairfax, VA, UNITED STATES

CONTINUING DATA

This application has PRO of 62945154 12/07/2019

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

12/15/2020

**** SMALL ENTITY ****

STATE OR COUNTRY

UNITED STATES

ADDRESS

ALIREZA BABAEI
4525 Gilbertson Road
Fairfax, VA 22032
UNITED STATES

FILING FEE RECEIVED

$3,210

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/113,851	12/07/2020	Alireza Babaei	2019-006Ut	2812

148908 7590 01/07/2021
ALIREZA BABAEI
4525 Gilbertson Road
Fairfax, VA 22032

EXAMINER

ART UNIT	PAPER NUMBER
2414	

MAIL DATE	DELIVERY MODE
01/07/2021	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

Decision Granting Request for Prioritized Examination (Track I)	**Application No.** 17/113,851	**Applicant(s)** Babaei, Alireza	
	Examiner CHERYL P GIBSON BAYLOR	**Art Unit** OPET	**AIA (FITF) Status** Yes

1. THE REQUEST FILED 07 December 2020 IS **GRANTED** .

   The above-identified application has met the requirements for prioritized examination
   A. ☑ for an original nonprovisional application (Track I).
   B. ☐ for an application undergoing continued examination (RCE).

2. **The above-identified application will undergo prioritized examination**. The application will be accorded special status throughout its entire course of prosecution until one of the following occurs:

   A. filing a **petition for extension of time** to extend the time period for filing a reply;

   B. filing an **amendment to amend the application to contain more than four independent claims, more than thirty total claims** , or a multiple dependent claim;

   C. filing a **request for continued examination** ;

   D. filing a notice of appeal;

   E. filing a request for suspension of action;

   F. mailing of a notice of allowance;

   G. mailing of a final Office action;

   H. completion of examination as defined in 37 CFR 41.102; or

   I. abandonment of the application.

Telephone inquiries with regard to this decision should be directed to CHERYL GIBSON BAYLOR at (571)272-3213. In his/her absence, calls may be directed to Petition Help Desk at (571) 272-3282.

/CHERYL GIBSON BAYLOR/ Paralegal Specialist, OPET	

U.S. Patent and Trademark Office
PTO-2298 (Rev. 02-2012)

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www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
17/113,851	12/07/2020	3747	1040	2019-006Ut	20	1

CONFIRMATION NO. 2812

148908
ALIREZA BABAEI
4525 Gilbertson Road
Fairfax, VA 22032

FILING RECEIPT

OC000000122052537

Date Mailed: 12/16/2020

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Alireza Babaei, Fairfax, VA;

Applicant(s)

Alireza Babaei, Fairfax, VA;

Power of Attorney: The patent practitioners associated with Customer Number 148908

Domestic Priority data as claimed by applicant

This appln claims benefit of 62/945,154 12/07/2019

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 12/15/2020

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/113,851**

Projected Publication Date: 06/10/2021

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****
Title

BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY

Preliminary Class

123

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/113,851

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	80		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	350		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	400		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*	x 50 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =	*	x 240 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			210			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	1040		TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
AMENDMENT A	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
AMENDMENT A	Application Size Fee (37 CFR 1.16(s))									
AMENDMENT A	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)	OR	RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
AMENDMENT B	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
AMENDMENT B	Application Size Fee (37 CFR 1.16(s))									
AMENDMENT B	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	17113851
Filing Date	2020-12-07
First Named Inventor	Alireza Babaei
Art Unit	
Examiner Name	
Attorney Docket Number	2019-006Ut

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	Filing Date	2020-12-07
	First Named Inventor	Alireza Babaei
	Art Unit	
	Examiner Name	
	Attorney Docket Number	2019-006Ut

	1	3GPP TS 38.211 V15.7.0 (2019-09); Technical Specification; 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Physical channels and modulation; (Release 15)	
	2	3GPP TS 38.212 V15.7.0 (2019-09); Technical Specification; 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Multiplexing and channel coding; (Release 15)	
	3	3GPP TS 38.213 V15.7.0 (2019-09); Technical Specification; 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Physical layer procedures for control; (Release 15)	
	4	3GPP TS 38.214 V15.7.0 (2019-09); Technical Specification; 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Physical layer procedures for data; (Release 15)	
	5	3GPP TS 38.300 V15.7.0 (2019-09); Technical Specification; 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; NR and NG-RAN Overall Description; Stage 2; (Release 15)	
	6	3GPP TS 38.321 V15.7.0 (2019-09); Technical Specification; 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Medium Access Control (MAC) protocol specification; (Release 15)	
	7	3GPP TS 38.331 V15.7.0 (2019-09); Technical Specification; 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Radio Resource Control (RRC); Protocol specification; (Release 15)	
	8	3GPP RAN WG2 Meeting #107; R2-1909604; Prague, Czech Republic, Aug. 26–30th, 2019 Revision of R2-1906403; Agenda Item: 11.2.1.2; Source: InterDigital; Title: Handling UL LBT Failures in MAC; Document for: Discussion, Decision	
	9	3GPP TSG-RAN WG2 Meeting #107bis; R2-1912095; Chongqing, China, 14th Oct. – 18th Oct 2019; Agenda Item: 6.2.2.2; Source: OPPO; Title: Remaining issues of detecting uplink LBT failure in NR-U; Document for: Discussion, Decision	
	10	3GPP TSG-RAN WG2 Meeting #107bis; R2-1912096; Chongqing, China, 14th Oct. – 18th Oct 2019; Agenda Item: 6.2.2.2; Source: OPPO; Title: Uplink LBT failure recovery for NR-U; Document for: Discussion, Decision	
	11	3GPP TSG-RAN WG2 Meeting #107bis; R2-1912177; Chongqing, China, 14th – 18th Oct, 2019; Source: vivo; Title: Remaining issues of uplink LBT failure; Agenda Item: 6.2.1.2; Document for: Discussion and Decision	

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	Filing Date	2020-12-07
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	Art Unit	
	Examiner Name	
	Attorney Docket Number	2019-006Ut

	12	3GPP TSG-RAN WG2 Meeting #107bis; R2-1912178; Chongqing, China, 14th – 18th Oct, 2019; Source: vivo; Title: Issue on the autonomous BWP switching; Agenda Item: 6.2.1.2; Document for: Discussion and Decision	
	13	3GPP TSG-RAN2#107bis; R2-1912304; Chongqing, China, October 14-18, 2019; Agenda item: 6.2.1.4; Source: Qualcomm Incorporated; Title: Details of the Uplink LBT failure mechanism; Document for: Discussion/Decision	
	14	3GPP TSG-RAN WG2 Meeting #107bis; R2-1912474; Chongqing, China, 14–18 October 2019; Agenda item: 6.2.2.2; Source: Samsung; Title: Recovery of consistent UL LBT failures; Document for: Discussion and Agreement	
	15	3GPP TSG-RAN WG2 Meeting #107bis; R2-1912569; Chongqing, China, 14th-18th October 2019; Source: Panasonic; Title: Handling UL LBT Failures in NR-U; Agenda Item: 6.2.2.2; Document for: Discussion and Decision	
	16	3GPP TSG-RAN WG2 107bis; R2-1912625; Chongqing, China, October 14-18, 2019; Agenda Item: 6.2.1.2; Source: Intel Corporation; Title: Detecting and Handling of UL LBT failures; Document for: Discussion and Decision	
	17	3GPP TSG-RAN WG2 Meeting #107bis; R2-1912684; Chongqing, China, 14th - 18th October 2019; resubmission of R2-1910099; Agenda item: 6.2.2.2; Source: Lenovo, Motorola Mobility; Title: Impact of systematic LBT failure on UL transmission procedure; Document for: Discussion and Decision	
	18	3GPP RAN WG2 Meeting #107bis; R2-1912889; Chongqing, China, Oct. 14–18th, 2019; Revision of R2-1909604; Agenda Item: 6.2.2.2; Source: InterDigital; Title: Handling UL LBT Failures in MAC; Document for: Discussion, Decision	
	19	3GPP TSG-RAN WG2 Meeting 107bis; R2-1913029; Chongqing, China, 14 – 18 Oct., 2019; Agenda Item: 6.2.2.2; Source: Huawei, HiSilicon; Title: UL LBT failure; Document for: Discussion, Decision	
	20	3GPP TSG-RAN WG2 Meeting #107bis; R2-1913260; Chongqing, China, 14th - 18th October 2019; Agenda Item: 6.2.2.2; Souce: MediaTek Inc.; Title: On consistent LBT failures; Document for: Discussion and decision	
	21	3GPP TSG-RAN WG2 Meeting #107bis; R2-1913287; Chongqing, China, 14 – 18 October 2019; Agenda item: 6.2.2.2; Source: Nokia, Nokia Shanghai Bell; Title: Remaining issues on UL LBT; WID/SID: NR_unlic-Core – Release 16; Document for: Discussion and Decision	
	22	3GPP TSG-RAN WG2 Meeting #107bis; R2-1913294; Chongqing, China, 14th – 18th October 2019; Agenda Item: 6.2.2.2; Source: Fujitsu; Title: UE behaviour upon consistent UL LBT failures; Document for: Discussion & Decision	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	17113851
	Filing Date	2020-12-07
	First Named Inventor	Alireza Babaei
	Art Unit	
	Examiner Name	
	Attorney Docket Number	2019-006Ut

	23	3GPP TSG-RAN WG2 Meeting #107bis; R2-1913649; Chongqing, China, 14th - 18th October 2019; Agenda item: 6.2.2.2; Source: Charter Communications; Title: Remaining Issues on Consistent LBT Failure Detection in NRU; WID/SID: NR-U WID - Release 16; Document for: Discussion and Decision	
	24	3GPP TSG-RAN WG2 Meeting #108; R2-1914367; Reno, USA, Nov 18-22, 2019; Source: vivo; Title: Remaining issues on uplink LBT failure; Agenda Item: 6.2.2.2; Document for: Discussion and Decision	
	25	3GPP TSG-RAN WG2 Meeting #108; R2-1914400; Reno, USA, 18th Nov– 22nd Nov 2019; Agenda Item: 6.2.2.2; Source: OPPO; Title: Remaining issues of consistent UL LBT failure; Document for: Discussion, Decision	
	26	3GPP TSG-RAN WG2 108; R2-1914572; Reno, USA, November 18-22, 2019; Agenda Item: 6.2.2.2; Source: Intel Corporation; Title: Handling of UL LBT failures; Document for: Discussion and Decision	
	27	3GPP TSG RAN WG2 NR #108 Meeting; R2-1914791; Reno, USA, 18 - 22 November, 2019; Agenda Item: 6.2.2.2; Source: ZTE Corporation, Sanechips; Title: LBT failure report on SCell; Document for: Discussion and Decision	
	28	3GPP TSG-RAN WG2 Meeting #108; R2-1915015; Reno, USA, 18 – 22 November 2019; Revision of R2-1912243; Agenda item: 6.2.2.2; Source: Spreadtrum Communications, Huawei, HiSilicon; Title: LBT Failures Handling in Non-Connected State; Document for: Discussion and Decision	
	29	3GPP TSG-RAN WG2 Meeting #108; R2-1915105; Reno, USA, 18th - 22nd November 2019; Agenda item: 6.2.2.2; Source: Lenovo, Motorola Mobility; Title: UE behavior upon consistent LBT failure; Document for: Discussion and Decision	
	30	3GPP TSG-RAN WG2 Meeting 108; R2-1915141; Reno, USA, 18th- 22nd November 2019; Agenda Item: 6.2.2.2; Source: Huawei, HiSilicon; Title: Handling of UL LBT failure; Document for: Discussion, Decision	
	31	3GPP TSG-RAN WG2 Meeting #108; R2-1915177; Reno, USA, 18th Nov – 22nd Nov 2019; Source: Panasonic; Title: Remaining issue on detecting UL LBT Failures; Agenda Item: 6.2.2.2; Document for: Discussion and Decision	
	32	3GPP TSG-RAN WG2 Meeting #108; R2-1915197; Reno, USA, 18th Nov – 22th Nov 2019; Agenda item: 6.2.2.2 Source: CMCC; Title: Details on determining consistent LBT failure of a BWP; Document for: Discussion	
	33	3GPP TSG-RAN WG2 Meeting #108; R2-1915544; Reno, USA, 18th – 22nd November 2019; Revision of R2-1913260; Agenda Item: 6.2.2.2; Source: MediaTek Inc.; Title: Remaining issues on consistent LBT failures; Document for: Discussion and decision	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	17113851
	Filing Date	2020-12-07
	First Named Inventor	Alireza Babaei
	Art Unit	
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	Attorney Docket Number	2019-006Ut

	34	3GPP TSG-RAN WG2 Meeting #108; R2-1915765; Reno, NV, USA 18-22 November 2019; Agenda item: 6.2.2.4; Source: Qualcomm Incorporated; Title: Remaining details of UL LBT failure mechanism; Document for: Discussion and Decision	
	35	3GPP TSG-RAN WG2 Meeting #108; R2-1915885; Reno, USA, 18 – 22 November 2019; update of R2-1913287; Agenda item: 6.2.2.2; Source: Nokia, Nokia Shanghai Bell, InterDigital, MediaTek, OPPO; Title: UL LBT failure; Detection; WID/SID: NR_unlic-Core - Release 16; Document for: Discussion and Decision	
	36	3GPP TSG-RAN WG2 Meeting #108; R2-1915886; Reno, USA, 18 – 22 November 2019; Agenda item: 6.2.2.2; Source: Nokia, Nokia Shanghai Bell; Title: UL LBT failure report; WID/SID: LTE_NR_DC_CA_enh-Core - Release 16; Document for: Discussion and Decision	

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	Filing Date	2020-12-07
	First Named Inventor	Alireza Babaei
	Art Unit	
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	Attorney Docket Number	2019-006Ut

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See attached certification statement.

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Alireza Babaei/	Date (YYYY-MM-DD)	2020-12-11
Name/Print	Alireza Babaei	Registration Number	75833

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Application Number:	17113851
International Application Number:	
Confirmation Number:	2812
Title of Invention:	BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY
First Named Inventor/Applicant Name:	Alireza Babaei
Customer Number:	148908
Filer:	Alireza Babaei
Filer Authorized By:	
Attorney Docket Number:	2019-006Ut
Receipt Date:	11-DEC-2020
Filing Date:	
Time Stamp:	14:33:33
Application Type:	Utility under 35 USC 111(a)

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Information:					
32	Non Patent Literature	NPL31.pdf	92175 363bd0e86b9462091ae976c1597ed4c3080b9386	no	3
Warnings:					
Information:					
33	Non Patent Literature	NPL32.pdf	28600 6b2bc47657a6676940270f31e092db23d488b456	no	2
Warnings:					
Information:					
34	Non Patent Literature	NPL33.pdf	240510 a76d53f18e73e778caa187b4b89463d00884e0b1	no	3
Warnings:					
Information:					
35	Non Patent Literature	NPL34.pdf	52807 efb54568db0d6bd77bb0818bf324c705b90ecf4c	no	3
Warnings:					
Information:					

36	Non Patent Literature	NPL35.pdf	47346 dc8f9e74e6c306e2b4b31d4e6884f8be37941eea	no	3
Warnings:					
Information:					
37	Non Patent Literature	NPL36.pdf	43032 7283ddaa078f8c9ac3ce5225193095af128777e8	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	13045725	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY.DOCKET NO./TITLE	REQUEST ID
17/113,851	12/07/2020	Alireza Babaei	2019-006Ut	126843

Acknowledgement of Change to Small Entity Status

The entity status change request below filed through Private PAIR on 12/07/2020 has been accepted.

CERTIFICATIONS:

Change of Entity Status:

X Applicant asserting small entity status. See 37 CFR 1.27.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

This portion must be completed by the signatory or signatories making the entity status change in accordance with 37 CFR 1.4(d)(4).

Signature:	/Alireza Babaei/
Name:	Alireza Babaei
Registration Number:	75833

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82A (07-13)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	
Filing Date	December 7, 2020
First Named Inventor	Alireza Babaei
Title	BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY
Art Unit	
Examiner Name	
Attorney Docket Number	2019-006Ut

SIGNATURE of Applicant or Patent Practitioner

Signature	/Alireza Babaei/	Date (Optional)	
Name	Alireza Babaei	Registration Number	75,833
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 148908

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

☑ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☐ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	/Alireza Babaei/	Date (Optional)	
Name	Alireza Babaei		
Title			

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY
First Named Inventor/Applicant Name:	Alireza Babaei
Filer:	Alireza Babaei
Attorney Docket Number:	2019-006Ut

Filed as Small Entity

Filing Fees for Track I Prioritized Examination - Nonprovisional Application under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY FILING FEE (ELECTRONIC FILING)	4011	1	80	80
UTILITY SEARCH FEE	2111	1	350	350
UTILITY EXAMINATION FEE	2311	1	400	400
REQUEST FOR PRIORITIZED EXAMINATION	2817	1	2100	2100
Pages:				
UTILITY APPL SIZE FEE PER 50 SHEETS >100	2081	1	210	210
Claims:				
Miscellaneous-Filing:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
PROCESSING FEE, EXCEPT PROV. APPLS.	2830	1	70	70
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**3210**

Electronic Acknowledgement Receipt	
EFS ID:	41314478
Application Number:	17113851
International Application Number:	
Confirmation Number:	2812
Title of Invention:	BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY
First Named Inventor/Applicant Name:	Alireza Babaei
Customer Number:	148908
Filer:	Alireza Babaei
Filer Authorized By:	
Attorney Docket Number:	2019-006Ut
Receipt Date:	07-DEC-2020
Filing Date:	
Time Stamp:	16:49:50
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$3210
RAM confirmation Number	E2020B7G52009401
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	TrackOne Request	2019-006Ut_Track1Req.pdf	140378 902cd123c009a062b3f6a50d00817141712f94f5	no	2
Warnings:					
Information:					
2	Application Data Sheet	2019-006Ut_ADS.pdf	1255753 8b0fce577fb3830cbba8ef9fa8dd870921a23093	no	8
Warnings:					
Information:					
3	Specification	2019-006Ut_Specification.pdf	509793 e611173548e7ba7434b683b5c7fd7ee9f80119da	no	103
Warnings:					
Information:					
4	Claims	2019-006Ut_Claims.pdf	21989 c50c5773c51eb32b82ca46815de1698ff791fe2f	no	3
Warnings:					
Information:					
5	Drawings-only black and white line drawings	2019-006Ut_Drawings.pdf	441222 abf04d44d4bc0f195d680874efe38c08fb12c726	no	47
Warnings:					
Information:					
6	Abstract	2019-006Ut_Abstract.pdf	11825 9afcb04bb8caff8d2a629f880d4bb78293e2ec26	no	1
Warnings:					
Information:					

7	Oath or Declaration filed	2019-006Ut_Declaration.pdf	225145 23afbbfcf2c50647f80eeff92cc34616bce4453e	no	2
Warnings:					
Information:					
8	Power of Attorney	2019-006Ut_PoA.pdf	296102 82259f1ab678feada56b92096316879438c773d7	no	2
Warnings:					
Information:					
9	Fee Worksheet (SB06)	fee-info.pdf	41551 ac11c3f2c16fb3ca611aef8fbbfa8f5734f1225d	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	2943758	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc Code: TRACK1.REQ
Document Description: TrackOne Request

PTO/SB/424 (12-11)

CERTIFICATION AND REQUEST FOR PRIORITIZED EXAMINATION UNDER 37 CFR 1.102(e) (Page 1 of 1)

First Named Inventor:	Alireza Babaei	Nonprovisional Application Number (if known):	
Title of Invention:	BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY		

APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS PRIORITIZED EXAMINATION FOR THE ABOVE-IDENTIFIED APPLICATION.

1. The processing fee set forth in 37 CFR 1.17(i), the prioritized examination fee set forth in 37 CFR 1.17(c), and if not already paid, the publication fee set forth in 37 CFR 1.18(d) have been filed with the request. The basic filing fee, search fee, examination fee, and any required excess claims and application size fees are filed with the request or have been already been paid.

2. The application contains or is amended to contain no more than four independent claims and no more than thirty total claims, and no multiple dependent claims.

3. The applicable box is checked below:

I. ☑ Original Application (Track One) - Prioritized Examination under § 1.102(e)(1)

i. (a) The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a). This certification and request is being filed with the utility application via EFS-Web.

---OR---

(b) The application is an original nonprovisional plant application filed under 35 U.S.C. 111(a). This certification and request is being filed with the plant application in paper.

ii. An executed oath or declaration under 37 CFR 1.63 is filed with the application.

II. ☐ Request for Continued Examination - Prioritized Examination under § 1.102(e)(2)

i. A request for continued examination has been filed with, or prior to, this form.
ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C. 371.
iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

Signature /Alireza Babaei/	Date 12/7/2020
Name (Print/Typed) Alireza Babaei	Practitioner Registration Number 75,833

Note: *Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required in accordance with 37 CFR 1.33 and 11.18. Please see 37 CFR 1.4(d) for the form of the signature. If necessary, submit multiple forms for more than one signature, see below*.*

☑ *Total of 1 forms are submitted.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2019-006Ut
	Application Number	
Title of Invention	BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Alireza		Babaei	

Residence Information (Select One) ● US Residency Non US Residency Active US Military Service

City	Fairfax	State/Province	VA	Country of Residence	US

Mailing Address of Inventor:

Address 1	4525 Gilbertson Road		
Address 2			
City	Fairfax	State/Province	VA
Postal Code	22032	Country i	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	148908		
Email Address	ar.babaei@gmail.com	Add Email	Remove Email

Application Information:

Title of the Invention	BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY		
Attorney Docket Number	2019-006Ut	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	47	Suggested Figure for Publication (if any)	34

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2019-006Ut
	Application Number	
Title of Invention	BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	● Customer Number	US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	148908		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Claims benefit of provisional	62945154	2019-12-07

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2019-006Ut
	Application Number	
Title of Invention	BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY	

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2019-006Ut
	Application Number	
Title of Invention	BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2019-006Ut
	Application Number	
Title of Invention	BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY	

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Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

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If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

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This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

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First Name	Alireza	Last Name	Babaei	Registration Number	75833

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2019-006Ut
	Application Number	
Title of Invention	BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 62/945,154, filed December 7, 2019, which is hereby incorporated by reference in its entirety.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] FIG. 1A and FIG. 1B show examples of mobile communications systems in accordance with several of various embodiments of the present disclosure.

[0003] FIG. 2A and FIG. 2B show examples of user plane and control plane protocol layers in accordance with several of various embodiments of the present disclosure.

[0004] FIG. 3 shows example functions and services offered by protocol layers in a user plane protocol stack in accordance with several of various embodiments of the present disclosure.

[0005] FIG. 4 shows example flow of packets through the protocol layers in accordance with several of various embodiments of the present disclosure.

[0006] FIG. 5A shows example mapping of channels between layers of the protocol stack and different physical signals in downlink in accordance with several of various embodiments of the present disclosure.

[0007] FIG. 5B shows example mapping of channels between layers of the protocol stack and different physical signals in uplink in accordance with several of various embodiments of the present disclosure.

[0008] FIG. 6 shows example physical layer processes for signal transmission in accordance with several of various embodiments of the present disclosure.

[0009] FIG. 7 shows examples of RRC states and RRC state transitions in accordance with several of various embodiments of the present disclosure.

[0010] FIG. 8 shows an example time domain transmission structure in NR by grouping OFDM symbols into slots, subframes and frames in accordance with several of various embodiments of the present disclosure.

[0011] FIG. 9 shows an example of time-frequency resource grid in accordance with several of various embodiments of the present disclosure.

[0012] FIG. 10 shows example adaptation and switching of bandwidth parts in accordance with several of various embodiments of the present disclosure.

[0013] FIG. 11A shows example arrangements of carriers in carrier aggregation in accordance with several of various embodiments of the present disclosure.

[0014] FIG. 11B shows examples of uplink control channel groups in accordance with several of various embodiments of the present disclosure.

[0015] FIG. 12A, FIG. 12B and FIG. 12C show example random access processes in accordance with several of various embodiments of the present disclosure.

[0016] FIG. 13A shows example time and frequency structure of SSBs and their associations with beams in accordance with several of various embodiments of the present disclosure.

[0017] FIG. 13B shows example time and frequency structure of CSI-RSs and their association with beams in accordance with several of various embodiments of the present disclosure.

[0018] FIG. 14A, FIG. 14B and FIG. 14C show example beam management processes in accordance with several of various embodiments of the present disclosure.

[0019] FIG. 15 shows example components of a wireless device and a base station that are in communication via an air interface in accordance with several of various embodiments of the present disclosure.

[0020] FIG. 16 shows example channel access parameters for listen before talk in accordance with several of various embodiments of the present disclosure.

[0021] FIG. 17 shows an example LBT failure indication in accordance with several of various embodiments of the present disclosure.

[0022] FIG. 18 shows scheduling request transmission for consistent LBT failures recovery in accordance with several of various embodiments of the present disclosure.

[0023] FIG. 19 shows example scheduling request and random access processes for consistent LBT failures recovery in accordance with several of various embodiments of the present disclosure.

[0024] FIG. 20 shows example random access processes for consistent LBT failures recovery in accordance with several of various embodiments of the present disclosure.

[0025] FIG. 21 shows scheduling request transmission for beam failure recovery in accordance with several of various embodiments of the present disclosure.

[0026] FIG. 22 shows example scheduling request and random access processes for beam failure recovery in accordance with several of various embodiments of the present disclosure.

[0027] FIG. 23 shows an example process in accordance with several of various embodiments of the present disclosure.

[0028] FIG. 24 shows an example process in accordance with several of various embodiments of the present disclosure.

[0029] FIG. 25 shows an example process in accordance with several of various embodiments of the present disclosure.

[0030] FIG. 26 shows an example process in accordance with several of various embodiments of the present disclosure.

[0031] FIG. 27 shows an example process in accordance with several of various embodiments of the present disclosure.

[0032] FIG. 28 shows an example process in accordance with several of various embodiments of the present disclosure.

[0033] FIG. 29 shows an example process in accordance with several of various embodiments of the present disclosure.

[0034] FIG. 30 shows an example process in accordance with several of various embodiments of the present disclosure.

[0035] FIG. 31 shows an example process in accordance with several of various embodiments of the present disclosure.

[0036] FIG. 32 shows an example process in accordance with several of various embodiments of the present disclosure.

[0037] FIG. 33 shows an example process in accordance with several of various embodiments of the present disclosure.

[0038] FIG. 34 shows an example process in accordance with several of various embodiments of the present disclosure.

[0039] FIG. 35 shows an example process in accordance with several of various embodiments of the present disclosure.

[0040] FIG. 36 shows an example process in accordance with several of various embodiments of the present disclosure.

[0041] FIG. 37 shows an example process in accordance with several of various embodiments of the present disclosure.

[0042] FIG. 38 shows an example process in accordance with several of various embodiments of the present disclosure.

[0043] FIG. 39 shows an example process in accordance with several of various embodiments of the present disclosure.

[0044] FIG. 40 shows an example flow diagram in accordance with several of various embodiments of the present disclosure.

[0045] FIG. 41 shows an example flow diagram in accordance with several of various embodiments of the present disclosure.

[0046] FIG. 42 shows an example flow diagram in accordance with several of various embodiments of the present disclosure.

[0047] FIG. 43 shows an example flow diagram in accordance with several of various embodiments of the present disclosure.

[0048] FIG. 44 shows an example flow diagram in accordance with several of various embodiments of the present disclosure.

[0049] FIG. 45 shows an example flow diagram in accordance with several of various embodiments of the present disclosure.

[0050] FIG. 46 shows an example flow diagram in accordance with several of various embodiments of the present disclosure.

[0051] FIG. 47 shows an example flow diagram in accordance with several of various embodiments of the present disclosure.

DETAILED DESCRIPTION

[0052] The exemplary embodiments of the disclosed technology enable operation of a wireless device and/or one or more base stations in unlicensed or shared spectrum and/or using beamforming. The exemplary disclosed embodiments may be implemented in the technical field of wireless communication systems. More particularly, the embodiment of the disclosed technology may relate to beam failure and consistent listen-before-talk (LBT) failure recovery.

[0053] The devices and/or nodes of the mobile communications system disclosed herein may be implemented based on various technologies and/or various releases/versions/amendments of a technology. The various technologies include various releases of long-term evolution (LTE) technologies, various releases of 5G new radio (NR) technologies, various wireless local area networks technologies and/or a combination thereof and/or alike. For example, a base station may

support a given technology and may communicate with wireless devices with different characteristics. The wireless devices may have different categories that define their capabilities in terms of supporting various features. The wireless device with the same category may have different capabilities. The wireless devices may support various technologies such as various releases of LTE technologies, various releases of 5G NR technologies and/or a combination thereof and/or alike. At least some of the wireless devices in the mobile communications system of the present disclosure may be stationary or almost stationary. In this disclosure, the terms "mobile communications system" and "wireless communications system" may be used interchangeably.

[0054] FIG. 1A shows an example of a mobile communications system 100 in accordance with several of various embodiments of the present disclosure. The mobile communications system 100 may be, for example, run by a mobile network operator (MNO) or a mobile virtual network operator (MVNO). The mobile communications system 100 may be a public land mobile network (PLMN) run by a network operator providing a variety of service including voice, data, short messaging service (SMS), multimedia messaging service (MMS), emergency calls, etc. The mobile communications system 100 includes a core network (CN) 106, a radio access network (RAN) 104 and at least one wireless device 102.

[0055] The CN 106 connects the RAN 104 to one or more external networks (e.g., one or more data networks such as the Internet) and is responsible for functions such as authentication, charging and end-to-end connection establishment. Several radio access technologies (RATs) may be served by the same CN 106.

[0056] The RAN 104 may implement a RAT and may operate between the at least one wireless device 102 and the CN 106. The RAN 104 may handle radio related functionalities such as scheduling, radio resource control, modulation and coding, multi-antenna transmissions and retransmission protocols. The wireless device and the RAN may share a portion of the radio spectrum by separating transmissions from the wireless device to the RAN and the transmissions from the RAN to the wireless device. The direction of the transmissions from the wireless device to the RAN is known as the uplink and the direction of the transmissions from the RAN to the wireless device is known as the downlink. The separation of uplink and downlink transmissions may be achieved by employing a duplexing technique. Example duplexing techniques include frequency division duplexing (FDD), time division duplexing (TDD) or a combination of FDD and TDD.

[0057] In this disclosure, the term wireless device may refer to a device that communicates with a network entity or another device using wireless communication techniques. The wireless device may be a mobile device or a non-mobile (e.g., fixed) device. Examples of the wireless device include cellular phone, smart phone, tablet, laptop computer, wearable device (e.g., smart watch, smart shoe, fitness trackers, smart clothing, etc.), wireless sensor, wireless meter, extended reality (XR) devices including augmented reality (AR) and virtual reality (VR) devices, Internet of Things (IoT) device, vehicle to vehicle communications device, road-side units (RSU), automobile, relay node or any combination thereof. In some examples, the wireless device (e.g., a smart phone, tablet, etc.) may have an interface (e.g., a graphical user interface (GUI)) for configuration by an end user. In some examples, the wireless device (e.g., a wireless sensor device, etc.) may not have an interface for configuration by an end user. The wireless device may be referred to as a user equipment (UE), a mobile station (MS), a subscriber unit, a handset, an access terminal, a user terminal, a wireless transmit and receive unit (WTRU) and/or other terminology.

[0058] The at least one wireless device may communicate with at least one base station in the RAN 104. In this disclosure, the term base station may encompass terminologies associated with various RATs. For example, a base station may be referred to as a Node B in a 3G cellular system such as Universal Mobile Telecommunication Systems (UMTS), an evolved Node B (eNB) in a 4G cellular system such as evolved universal terrestrial radio access (E-UTRA), a next generation eNB (ng-eNB), a Next Generation Node B (gNB) in NR and/or a 5G system, an access point (AP) in Wi-Fi and/or other wireless local area networks. A base station may be referred to as a remote radio head (RRH), a baseband unit (BBU) in connection with one or more RRHs, a repeater or relay for coverage extension and/or any combination thereof. In some examples, all protocol layers of a base station may be implemented in one unit. In some example, some of the protocol layers (e.g., upper layers) of the base station may be implemented in a first unit (e.g., a central unit (CU)) and some other protocol layer (e.g., lower layers) may be implemented in one or more second units (e.g., distributed units (DUs)).

[0059] A base station in the RAN 104 includes one or more antennas to communicate with the at least one wireless device. The base station may communicate with the at least one wireless device using radio frequency (RF) transmissions and receptions via RF transceivers. The base station antennas may control one or more cells (or sectors). The size and/or radio coverage area of a cell may depend on the range that transmissions by a wireless device can be successfully received by

the base station when the wireless device transmits using the RF frequency of the cell. The base station may be associated with cells of various sizes. At a given location, the wireless device may be in coverage area of a first cell of the base station and may not be in coverage area of a second cell of the base station depending on the sizes of the first cell and the second cell.

[0060] A base station in the RAN 104 may have various implementations. For example, a base station may be implemented by connecting a BBU (or a BBU pool) coupled to one or more RRHs and/or one or more relay nodes to extend the cell coverage. The BBU pool may be located at a centralized site like a cloud or data center. The BBU pool may be connected to a plurality of RRHs that control a plurality of cells. The combination of BBU with the one or more RRHs may be referred to as a centralized or cloud RAN (C-RAN) architecture. In some implementations, the BBU functions may be implemented on virtual machines (VMs) on servers at a centralized location. This architecture may be referred to as virtual RAN (vRAN). All, most or a portion of the protocol layer functions (e.g., all or portions of physical layer, medium access control (MAC) layer and/or higher layers) may be implemented at the BBU pool and the processed data may be transmitted to the RRHs for further processing and/or RF transmission. The links between the BBU pool and the RRHs may be referred to as fronthaul.

[0061] In some deployment scenarios, the RAN 104 may include macrocell base stations with high transmission power levels and large coverage areas. In other deployment scenarios, the RAN 104 may include base stations that employ different transmission power levels and/or have cells with different coverage areas. For example, some base station may be macrocell base stations with high transmission powers and /or large coverage areas and other base station may be small cell base stations with comparatively smaller transmission powers and/or coverage areas. In some deployment scenarios, a small cell base station may have coverage that is within or has overlap with coverage area of a macrocell base station. A wireless device may communicate with the macrocell base station while within the coverage area of the macrocell base station. For additional capacity, the wireless device may communicate with both the macrocell base station and the small cell base station while in the overlapped coverage area of the macrocell base station and the small cell base station. Depending on their coverage areas, a small cell base station may be referred to as a microcell base station, a picocell base station, a femtocell base station or a home base station.

[0062] Different standard development organizations (SDOs) have specified, or may specify in future, mobile communications systems that have similar characteristics as the mobile

communications system 100 of FIG. 1A. For example, the Third-Generation Partnership Project (3GPP) is a group of SDOs that provides specifications that define 3GPP technologies for mobile communications systems that are akin to the mobile communications system 100. The 3GPP has developed specifications for third generation (3G) mobile networks, fourth generation (4G) mobile networks and fifth generation (5G) mobile networks. The 3G, 4G and 5G networks are also known as Universal Mobile Telecommunications System (UMTS), Long Term Evolution (LTE) and 5G system (5GS), respectively. In this disclosure, embodiments are described with respect to the RAN implemented in a 3GPP 5G mobile network that is also referred to as next generation RAN (NG-RAN). The embodiments may also be implemented in other mobile communications systems such as 3G or 4G mobile networks or mobile networks that may be standardized in future such as sixth generation (6G) mobile networks or mobile networks that are implemented by standards bodies other than 3GPP. The NG-RAN may be based on a new RAT known as new radio (NR) and/or other radio access technologies such as LTE and/or non-3GPP RATs.

[0063] FIG. 1B shows an example of a mobile communications system 110 in accordance with several of various embodiments of the present disclosure. The mobile communications system 110 of FIG. 1B is an example of a 5G mobile network and includes a 5G CN (5G-CN) 130, an NG-RAN 120 and UEs (collectively 112 and individually UE 112A and UE 112B). The 5G-CN 130, the NG-RAN 120 and the UEs 112 of FIG. 1B operate substantially alike the CN 106, the RAN 104 and the at least one wireless device 102, respectively, as described for FIG. 1A.

[0064] The 5G-CN 130 of FIG. 1B connects the NG-RAN 120 to one or more external networks (e.g., one or more data networks such as the Internet) and is responsible for functions such as authentication, charging and end-to-end connection establishment. The 5G-CN has new enhancements compared to previous generations of CNs (e.g., evolved packet core (EPC) in the 4G networks) including service-based architecture, support for network slicing and control plane/user plane split. The service-based architecture of the 5G-CN provides a modular framework based on service and functionalities provided by the core network wherein a set of network functions are connected via service-based interfaces. The network slicing enables multiplexing of independent logical networks (e.g., network slices) on the same physical network infrastructure. For example, a network slice may be for mobile broadband applications with full mobility support and a different network slice may be for non-mobile latency-critical applications such as industry automation. The control plane/user plane split enables independent scaling of the control plane and the user plane.

For example, the control plane capacity may be increased without affecting the user plane of the network.

[0065] The 5G-CN 130 of FIG. 1B includes an access and mobility management function (AMF) 132 and a user plane function (UPF) 134. The AMF 132 may support termination of non-access stratum (NAS) signaling, NAS signaling security such as ciphering and integrity protection, inter-3GPP access network mobility, registration management, connection management, mobility management, access authentication and authorization and security context management. The NAS is a functional layer between a UE and the CN and the access stratum (AS) is a functional layer between the UE and the RAN. The UPF 134 may serve as an interconnect point between the NG-RAN and an external data network. The UPF may support packet routing and forwarding, packet inspection and Quality of Service (QoS) handling and packet filtering. The UPF may further act as a Protocol Data Unit (PDU) session anchor point for mobility within and between RATs.

[0066] The 5G-CN 130 may include additional network functions (not shown in FIG. 1B) such as one or more Session Management Functions (SMFs), a Policy Control Function (PCF), a Network Exposure Function (NEF), a Unified Data Management (UDM), an Application Function (AF), and/or an Authentication Server Function (AUSF). These network functions along with the AMF 132 and UPF 134 enable a service-based architecture for the 5G-CN.

[0067] The NG-RAN 120 may operate between the UEs 112 and the 5G-CN 130 and may implement one or more RATs. The NG-RAN 120 may include one or more gNBs (e.g., gNB 122A or gNB 122B or collectively gNBs 122) and/or one or more ng-eNBs (e.g., ng-eNB 124A or ng-eNB 124B or collectively ng-eNBs 124). The general terminology for gNBs 122 and/or an ng-eNBs 124 is a base station and may be used interchangeably in this disclosure. The gNBs 122 and the ng-eNBs 124 may include one or more antennas to communicate with the UEs 112. The one or more antennas of the gNBs 122 or ng-eNBs 124 may control one or more cells (or sectors) that provide radio coverage for the UEs 112.

[0068] A gNB and/or an ng-eNB of FIG. 1B may be connected to the 5G-CN 130 using an NG interface. A gNB and/or an ng-eNB may be connected with other gNBs and/or ng-eNBs using an Xn interface. The NG or the Xn interfaces are logical connections that may be established using an underlying transport network. The interface between a UE and a gNB or between a UE and an ng-eNBs may be referred to as the Uu interface. An interface (e.g., Uu, NG or Xn) may be established by using a protocol stack that enables data and control signaling exchange between entities in the

mobile communications system of FIG. 1B. When a protocol stack is used for transmission of user data, the protocol stack may be referred to as user plane protocol stack. When a protocol stack is used for transmission of control signaling, the protocol stack may be referred to as control plane protocol stack. Some protocol layer may be used in both of the user plane protocol stack and the control plane protocol stack while other protocol layers may be specific to the user plane or control plane.

[0069] The NG interface of FIG. 1B may include an NG-User plane (NG-U) interface between a gNB and the UPF 134 (or an ng-eNB and the UPF 134) and an NG-Control plane (NG-C) interface between a gNB and the AMF 132 (or an ng-eNB and the AMF 132). The NG-U interface may provide non-guaranteed delivery of user plane PDUs between a gNB and the UPF or an ng-eNB and the UPF. The NG-C interface may provide services such as NG interface management, UE context management, UE mobility management, transport of NAS messages, paging, PDU session management, configuration transfer and/or warning message transmission.

[0070] The UEs 112 and a gNB may be connected using the Uu interface and using the NR user plane and control plane protocol stack. The UEs 112 and an ng-eNB may be connected using the Uu interface using the LTE user plane and control plane protocol stack.

[0071] In the example mobile communications system of FIG. 1B, a 5G-CN is connected to a RAN comprised of 4G LTE and/or 5G NR RATs. In other example mobile communications systems, a RAN based on the 5G NR RAT may be connected to a 4G CN (e.g., EPC). For example, earlier releases of 5G standards may support a non-standalone mode of operation where a NR based RAN is connected to the 4G EPC. In an example non-standalone mode, a UE may be connected to both a 5G NR gNB and a 4G LTE eNB (e.g., a ng-eNB) and the control plane functionalities (such as initial access, paging and mobility) may be provided through the 4G LTE eNB. In a standalone of operation, the 5G NR gNB is connected to a 5G-CN and the user plane and the control plane functionalities are provided by the 5G NR gNB.

[0072] FIG. 2A shows an example of the protocol stack for the user plan of an NR Uu interface in accordance with several of various embodiments of the present disclosure. The user plane protocol stack comprises five protocol layers that terminate at the UE 200 and the gNB 210. The five protocol layers, as shown in FIG. 2A, include physical (PHY) layer referred to as PHY 201 at the UE 200 and PHY 211 at the gNB 210, medium access control (MAC) layer referred to as MAC 202 at the UE 200 and MAC 212 at the gNB 210, radio link control (RLC) layer referred to as RLC

203 at the UE 200 and RLC 213 at the gNB 210, packet data convergence protocol (PDCP) layer referred to as PDCP 204 at the UE 200 and PDCP 214 at the gNB 210, and service data application protocol (SDAP) layer referred to as SDAP 205 at the UE 200 and SDAP 215 at the gNB 210. The PHY layer, also known as layer 1 (L1), offers transport services to higher layers. The other four layers of the protocol stack (MAC, RLC, PDCP and SDAP) are collectively known as layer 2 (L2).

[0073] FIG. 2B shows an example of the protocol stack for the control plan of an NR Uu interface in accordance with several of various embodiments of the present disclosure. Some of the protocol layers (PHY, MAC, RLC and PDCP) are common between the user plane protocol stack shown in FIG. 2A and the control plan protocol stack. The control plane protocol stack also includes the RRC layer, referred to RRC 206 at the UE 200 and RRC 216 at the gNB 210, that also terminates at the UE 200 and the gNB 210. In addition, the control plane protocol stack includes the NAS layer that terminates at the UE 200 and the AMF 220. In FIG. 2B, the NAS layer is referred to as NAS 207 at the UE 200 and NAS 227 at the AMF 220.

[0074] FIG. 3 shows example functions and services offered to other layers by a layer in the NR user plane protocol stack of FIG. 2A in accordance with several of various embodiments of the present disclosure. For example, the SDAP layer of FIG. 3 (shown in FIG. 2A as SDAP 205 at the UE side and SDAP 215 at the gNB side) may perform mapping and de-mapping of QoS flows to data radio bearers. The mapping and de-mapping may be based on QoS (e.g., delay, throughput, jitter, error rate, etc.) associated with a QoS flow. A QoS flow may be a QoS differentiation granularity for a PDU session which is a logical connection between a UE 200 and a data network. A PDU session may contain one or more QoS flows. The functions and services of the SDAP layer include mapping and de-mapping between one or more QoS flows and one or more data radio bearers. The SDAP layer may also mark the uplink and/or downlink packets with a QoS flow ID (QFI).

[0075] The PDCP layer of FIG. 3 (shown in FIG. 2A as PDCP 204 at the UE side and PDCP 214 at the gNB side) may perform header compression and decompression (e.g., using Robust Header Compression (ROHC) protocol) to reduce the protocol header overhead, ciphering and deciphering and integrity protection and verification to enhance the security over the air interface, reordering and in-order delivery of packets and discarding of duplicate packets. A UE may be configured with one PDCP entity per bearer.

[0076] In an example scenario not shown in FIG. 3, a UE may be configured with dual connectivity and may connect to two different cell groups provided by two different base stations. For example, a base station of the two base stations may be referred to as a master base station and a cell group provided by the master base station may be referred to as a master cell group (MCG). The other base station of the two base stations may be referred to as a secondary base station and the cell group provided by the secondary base station may be referred to as a secondary cell group (SCG). A bearer may be configured for the UE as a split bearer that may be handled by the two different cell groups. The PDCP layer may perform routing of packets corresponding to a split bearer to and/or from RLC channels associated with the cell groups.

[0077] In an example scenario not shown in FIG. 3, a bearer of the UE may be configured (e.g., with control signaling) with PDCP packet duplication. A bearer configured with PDCP duplication may be mapped to a plurality of RLC channels each corresponding to different one or more cells. The PDCP layer may duplicate packets of the bearer configured with PDCP duplication and the duplicated packets may be mapped to the different RLC channels. With PDCP packet duplication, the likelihood of correct reception of packets increases thereby enabling higher reliability.

[0078] The RLC layer of FIG. 3 (shown in FIG. 2A as RLC 203 at the UE side and RLC 213 at the gNB side) provides service to upper layers in the form of RLC channels. The RLC layer may include three transmission modes: transparent mode (TM), Unacknowledged mode (UM) and Acknowledged mode (AM). The RLC layer may perform error correction through automatic repeat request (ARQ) for the AM transmission mode, segmentation of RLC service data units (SDUs) for the AM and UM transmission modes and re-segmentation of RLC SDUs for AM transmission mode, duplicate detection for the AM transmission mode, RLC SDU discard for the AM and UM transmission modes, etc. The UE may be configured with one RLC entity per RLC channel.

[0079] The MAC layer of FIG. 3 (shown in FIG. 2A as MAC 202 at the UE side and MAC 212 at the gNB side) provides services to the RLC layer in form of logical channels. The MAC layer may perform mapping between logical channels and transport channels, multiplexing/demultiplexing of MAC SDUs belonging to one or more logical channels into/from transport blocks (TBs) delivered to/from the physical layer on transport channels, reporting of scheduling information, error correction through hybrid automatic repeat request (HARQ), priority handling between UEs by means of dynamic scheduling, priority handling between logical channels of one UE by means of logical channel prioritization and/or padding. In case of carrier aggregation, a MAC entity may

comprise one HARQ entity per cell. A MAC entity may support multiple numerologies, transmission timings and cells. The control signaling may configure logical channels with mapping restrictions. The mapping restrictions in logical channel prioritization may control the numerology(ies), cell(s), and/or transmission timing(s)/duration(s) that a logical channel may use.

[0080] The PHY layer of FIG. 3 (shown in FIG. 2A as PHY 201 at the UE side and PHY 211 at the gNB side) provides transport services to the MAC layer in form of transport channels. The physical layer may handle coding/decoding, HARQ soft combining, rate matching of a coded transport channel to physical channels, mapping of coded transport channels to physical channels, modulation and demodulation of physical channels, frequency and time synchronization, radio characteristics measurements and indication to higher layers, RF processing, and mapping to antennas and radio resources.

[0081] FIG. 4 shows example processing of packets at different protocol layers in accordance with several of various embodiments of the present disclosure. In this example, three Internet Protocol (IP) packets that are processed by the different layers of the NR protocol stack. The term SDU shown in FIG. 4 is the data unit that is entered from/to a higher layer. In contrast, a protocol data unit (PDU) is the data unit that is entered to/from a lower layer. The flow of packets in FIG. 4 is for downlink. An uplink data flow through layers of the NR protocol stack is similar to FIG. 4. In this example, the two leftmost IP packets are mapped by the SDAP layer (shown as SDAP 205 and SDAP 215 in FIG. 2A) to radio bearer 402 and the rightmost packet is mapped by the SDAP layer to the radio bearer 404. The SDAP layer adds SDAP headers to the IP packets which are entered into the PDCP layer as PDCP SDUs. The PDCP layer is shown as PDCP 204 and PDCP 214 in FIG. 2A. The PDCP layer adds the PDCP headers to the PDCP SDUs which are entered into the RLC layer as RLC SDUs. The RLC layer is shown as RLC 203 and RLC 213 in FIG. 2A. An RLC SDU may be segmented at the RLC layer. The RLC layer adds RLC headers to the RLC SDUs after segmentation (if segmented) which are entered into the MAC layer as MAC SDUs. The MAC layer adds the MAC headers to the MAC SDUs and multiplexes one or more MAC SDUs to form a PHY SDU (also referred to as a transport block (TB) or a MAC PDU).

[0082] In FIG. 4, the MAC SDUs are multiplexed to form a transport block. The MAC layer may multiplex one or more MAC control elements (MAC CEs) with zero or more MAC SDUs to form a transport block. The MAC CEs may also be referred to as MAC commands or MAC layer control signaling and may be used for in-band control signaling. The MAC CEs may be transmitted by a

base station to a UE (e.g., downlink MAC CEs) or by a UE to a base station (e.g., uplink MAC CEs). The MAC CEs may be used for transmission of information useful by a gNB for scheduling (e.g., buffer status report (BSR) or power headroom report (PHR)), activation/deactivation of one or more cells, activation/deactivation of configured radio resources for or one or more processes, activation/deactivation of one or more processes, indication of parameters used in one or more processes, etc.

[0083] FIG. 5A and FIG. 5B show example mapping between logical channels, transport channels and physical channels for downlink and uplink, respectively in accordance with several of various embodiments of the present disclosure. As discussed before, the MAC layer provides services to higher layer in the form of logical channels. A logical channel may be classified as a control channel, if used for transmission of control and/or configuration information, or a traffic channel if used for transmission of user data. Example logical channels in NR include Broadcast Control Channel (BCCH) used for transmission of broadcast system control information, Paging Control Channel (PCCH) used for carrying paging messages for wireless devices with unknown locations, Common Control Channel (CCCH) used for transmission of control information between UEs and network and for UEs that have no RRC connection with the network, Dedicated Control Channel (DCCH) which is a point-to-point bi-directional channel for transmission of dedicated control information between a UE that has an RRC connection and the network and Dedicated Traffic Channel (DTCH) which is point-to-point channel, dedicated to one UE, for the transfer of user information and may exist in both uplink and downlink.

[0084] As discussed before, the PHY layer provides services to the MAC layer and higher layers in the form of transport channels. Example transport channels in NR include Broadcast Channel (BCH) used for transmission of part of the BCCH referred to as master information block (MIB), Downlink Shared Channel (DL-SCH) used for transmission of data (e.g., from DTCH in downlink) and various control information (e.g., from DCCH and CCCH in downlink and part of the BCCH that is not mapped to the BCH), Uplink Shared Channel (UL-SCH) used for transmission of uplink data (e.g., from DTCH in uplink) and control information (e.g., from CCCH and DCCH in uplink) and Paging Channel (PCH) used for transmission of paging information from the PCCH. In addition, Random Access Channel (RACH) is a transport channel used for transmission of random access preambles. The RACH does not carry a transport block. Data on a transport channel (except

RACH) may be organized in transport blocks, wherein One or more transport blocks may be transmitted in a transmission time interval (TTI).

[0085] The PHY layer may map the transport channels to physical channels. A physical channel may correspond to time-frequency resources that are used for transmission of information from one or more transport channels. In addition to mapping transport channels to physical channels, the physical layer may generate control information (e.g., downlink control information (DCI) or uplink control information (UCI)) that may be carried by the physical channels. Example DCI include scheduling information (e.g., downlink assignments and uplink grants), request for channel state information report, power control command, etc. Example UCI include HARQ feedback indicating correct or incorrect reception of downlink transport blocks, channel state information report, scheduling request, etc. Example physical channels in NR include a Physical Broadcast Channel (PBCH) for carrying information from the BCH, a Physical Downlink Shared Channel (PDSCH) for carrying information form the PCH and the DL-SCH, a Physical Downlink Control Channel (PDCCH) for carrying DCI, a Physical Uplink Shared Channel (PUSCH) for carrying information from the UL-SCH and/or UCI, a Physical Uplink Control Channel (PUCCH) for carrying UCI and Physical Random Access Channel (PRACH) for transmission of RACH (e.g., random access preamble).

[0086] The PHY layer may also generate physical signals that are not originated from higher layers. As shown in FIG. 5A, example downlink physical signals include Demodulation Reference Signal (DM-RS), Phase Tracking Reference Signal (PT-RS), Channel State Information Reference Signal (CSI-RS), Primary Synchronization Signal (PSS) and Secondary Synchronization Signal (SSS). As shown in FIG. 5B, example uplink physical signals include DM-RS, PT-RS and sounding reference signal (SRS).

[0087] As indicated earlier, some of the protocol layers (PHY, MAC, RLC and PDCP) of the control plane of an NR Uu interface, are common between the user plane protocol stack (as shown in FIG. 2A) and the control plane protocol stack (as shown in FIG. 2B). In addition to PHY, MAC, RLC and PDCP, the control plane protocol stack includes the RRC protocol layer and the NAS protocol layer.

[0088] The NAS layer, as shown in FIG. 2B, terminates at the UE 200 and the AMF 220 entity of the 5G-C 130. The NAS layer is used for core network related functions and signaling including

registration, authentication, location update and session management. The NAS layer uses services from the AS of the Uu interface to transmit the NAS messages.

[0089] The RRC layer, as shown in FIG. 2B, operates between the UE 200 and the gNB 210 (more generally NG-RAN 120) and may provide services and functions such as broadcast of system information (SI) related to AS and NAS as well as paging initiated by the 5G-C 130 or NG-RAN 120. In addition, the RRC layer is responsible for establishment, maintenance and release of an RRC connection between the UE 200 and the NG-RAN 120, carrier aggregation configuration (e.g., addition, modification and release), dual connectivity configuration (e.g., addition, modification and release), security related functions, radio bearer configuration/maintenance and release, mobility management (e.g., maintenance and context transfer), UE cell selection and reselection, inter-RAT mobility, QoS management functions, UE measurement reporting and control, radio link failure (RLF) detection and NAS message transfer. The RRC layer uses services from PHY, MAC, RLC and PDCP layers to transmit RRC messages using signaling radio bearers (SRBs). The SRBs are mapped to CCCH logical channel during connection establishment and to DCCH logical channel after connection establishment.

[0090] FIG. 6 shows example physical layer processes for signal transmission in accordance with several of various embodiments of the present disclosure. Data and/or control streams from MAC layer may be encoded/decoded to offer transport and control services over the radio transmission link. For example, one or more (e.g., two as shown in FIG. 6) transport blocks may be received from the MAC layer for transmission via a physical channel (e.g., a physical downlink shared channel or a physical uplink shared channel). A cyclic redundancy check (CRC) may be calculated and attached to a transport block in the physical layer. The CRC calculation may be based on one or more cyclic generator polynomials. The CRC may be used by the receiver for error detection. Following the transport block CRC attachment, a low-density parity check (LDPC) base graph selection may be performed. In example embodiments, two LDPC base graphs may be used wherein a first LDPC base graph may be optimized for small transport blocks and a second LDPC base graph may be optimized for comparatively larger transport blocks.

[0091] The transport block may be segmented into code blocks and code block CRC may be calculated and attached to a code block. A code block may be LDPC coded and the LDPC coded blocks may be individually rate matched. The code blocks may be concatenated to create one or more codewords. The contents of a codeword may be scrambled and modulated to generate a block

of complex-valued modulation symbols. The modulation symbols may be mapped to a plurality of transmission layers (e.g., multiple-input multiple-output (MIMO) layers) and the transmission layers may be subject to transform precoding and/or precoding. The precoded complex-valued symbols may be mapped to radio resources (e.g., resource elements). The signal generator block may create a baseband signal and up-convert the baseband signal to a carrier frequency for transmission via antenna ports. The signal generator block may employ mixers, filters and/or other radio frequency (RF) components prior to transmission via the antennas. The functions and blocks in FIG. 6 are illustrated as examples and other mechanisms may be implemented in various embodiments.

[0092] FIG. 7 shows examples of RRC states and RRC state transitions at a UE in accordance with several of various embodiments of the present disclosure. A UE may be in one of three RRC states: RRC_IDLE 702, RRC INACTIVE 704 and RRC_CONNECTED 706. In RRC_IDLE 702 state, no RRC context (e.g., parameters needed for communications between the UE and the network) may be established for the UE in the RAN. In RRC_IDLE 702 state, no data transfer between the UE and the network may take place and uplink synchronization is not maintained. The wireless device may sleep most of the time and may wake up periodically to receive paging messages. The uplink transmission of the UE may be based on a random access process and to enable transition to the RRC_CONNECTED 706 state. The mobility in RRC_IDLE 702 state is through a cell reselection procedure where the UE camps on a cell based on one or more criteria including signal strength that is determined based on the UE measurements.

[0093] In RRC_CONNECTED 706 state, the RRC context is established and both the UE and the RAN have necessary parameters to enable communications between the UE and the network. In the RRC_CONNECTED 706 state, the UE is configured with an identity known as a Cell Radio Network Temporary Identifier (C-RNTI) that is used for signaling purposes (e.g., uplink and downlink scheduling, etc.) between the UE and the RAN. The wireless device mobility in the RRC_CONNECTED 706 state is managed by the RAN. The wireless device provides neighboring cells and/or current serving cell measurements to the network and the network may make hand over decisions. Based on the wireless device measurements, the current serving base station may send a handover request message to a neighboring base station and may send a handover command to the wireless device to handover to a cell of the neighboring base station. The transition of the wireless device from the RRC_IDLE 702 state to the RRC_CONNECTED 706 state or from the

RRC_CONNECTED 706 state to the RRC_IDLE 702 state may be based on connection establishment and connection release procedures (shown collectively as connection establishment/release 710 in FIG. 7).

[0094] To enable a faster transition to the RRC_CONNECTED 706 state (e.g., compared to transition from RRC_IDLE 702 state to RRC_CONNECTED 706 state), an RRC_INACTIVE 704 state is used for an NR UE wherein, the RRC context is kept at the UE and the RAN. The transition from the RRC_INACTIVE 704 state to the RRC_CONNECTED 706 state is handled by RAN without CN signaling. Similar to the RRC_IDLE 702 state, the mobility in RRC_INACTIVE 704 state is based on a cell reselection procedure without involvement from the network. The transition of the wireless device from the RRC_INACTIVE 704 state to the RRC_CONNECTED 706 state or from the RRC_CONNECTED 706 state to the RRC_INACTIVE 704 state may be based on connection resume and connection inactivation procedures (shown collectively as connection resume/inactivation 712 in FIG. 7). The transition of the wireless device from the RRC_INACTIVE 704 state to the RRC_IDLE 702 state may be based on a connection release 714 procedure as shown in FIG. 7.

[0095] In NR, Orthogonal Frequency Division Multiplexing (OFDM), also called cyclic prefix OFDM (CP-OFDM), is the baseline transmission scheme in both downlink and uplink of NR and the Discrete Fourier Transform (DFT) spread OFDM (DFT-s-OFDM) is a complementary uplink transmission in addition to the baseline OFDM scheme. OFDM is multi-carrier transmission scheme wherein the transmission bandwidth may be composed of several narrowband sub-carriers. The subcarriers are modulated by the complex valued OFDM modulation symbols resulting in an OFDM signal. The complex valued OFDM modulation symbols are obtained by mapping, by a modulation mapper, the input data (e.g., binary digits) to different points of a modulation constellation diagram. The modulation constellation diagram depends on the modulation scheme. NR may use different types of modulation schemes including Binary Phase Shift Keying (BPSK), $\pi/2$-BPSK, Quadrature Phase Shift Keying (QPSK), 16 Quadrature Amplitude Modulation (16QAM), 64QAM and 256QAM. Different and/or higher order modulation schemes (e.g., M-QAM in general) may be used. An OFDM signal with N subcarriers may be generated by processing N subcarriers in parallel for example by using Inverse Fast Fourier Transform (IFFT) processing. The OFDM receiver may use FFT processing to recover the transmitted OFDM modulation symbols. The subcarrier spacing of subcarriers in an OFDM signal is inversely

proportional to an OFDM modulation symbol duration. For example, for a 15 KHz subcarrier spacing, duration of an OFDM signal is nearly 66.7μs. To enhance the robustness of OFDM transmission in time dispersive channels, a cyclic prefix (CP) may be inserted at the beginning of an OFDM symbol. For example, the last part of an OFDM symbol may be copied and inserted at the beginning of an OFDM symbol. The CP insertion enhanced the OFDM transmission scheme by preserving subcarrier orthogonality in time dispersive channels.

[0096] In NR, different numerologies may be used for OFDM transmission. A numerology of OFDM transmission may indicate a subcarrier spacing and a CP duration for the OFDM transmission. For example, a subcarrier spacing in NR may generally be a multiple of 15 KHz and expressed as $\Delta f = 2^{\mu}.15\ KHz$ (μ=0, 1, 2, …). Example subcarrier spacings used in NR include 15KHz (μ=0), 30KHz (μ=1), 60 KHz (μ=2), 120 KHz (μ=3) and 240 KHz (μ=4). As discussed before, a duration of OFDM symbol is inversely proportional to the subcarrier spacing and therefor OFDM symbol duration may depend on the numerology (e.g. the μ value).

[0097] FIG. 8 shows an example time domain transmission structure in NR wherein OFDM symbols are grouped into slots, subframes and frames in accordance with several of various embodiments of the present disclosure. A slot is a group of N_{symb}^{slot} OFDM symbols, wherein the N_{symb}^{slot} may have a constant value (e.g., 14). Since different numerologies results in different OFDM symbol durations, duration of a slot may also depend on the numerology and may be variable. A subframe may have a duration of 1 ms and may be composed of one or more slots, the number of which may depend on the slot duration. The number of slots per subframe is therefore a function of μ and may generally expressed as $N_{slot}^{subframe,\mu}$ and the number of symbols per subframe may be expressed as $N_{symb}^{subframe,\mu} = N_{symb}^{slot} N_{slot}^{subframe,\mu}$. A frame may have a duration of 10 ms and may consist of 10 subframes. The number of slots per frame may depend on the numerology and therefore may be variable. The number of slots per frame may generally be expressed as $N_{slot}^{frame,\mu}$.

[0098] An antenna port may be defined as a logical entity such that channel characteristics over which a symbol on the antenna port is conveyed may be inferred from the channel characteristics over which another symbol on the same antenna port is conveyed. For example, for DM-RS associated with a PDSCH, the channel over which a PDSCH symbol on an antenna port is conveyed may be inferred from the channel over which a DM-RS symbol on the same antenna port

is conveyed, for example, if the two symbols are within the same resource as the scheduled PDSCH and/or in the same slot and/or in the same precoding resource block group (PRG). For example, for DM-RS associated with a PDCCH, the channel over which a PDCCH symbol on an antenna port is conveyed may be inferred from the channel over which a DM-RS symbol on the same antenna port is conveyed if, for example, the two symbols are within resources for which the UE may assume the same precoding being used. For example, for DM-RS associated with a PBCH, the channel over which a PBCH symbol on one antenna port is conveyed may be inferred from the channel over which a DM-RS symbol on the same antenna port is conveyed if, for example, the two symbols are within a SS/PBCH block transmitted within the same slot, and with the same block index. The antenna port may be different from a physical antenna. An antenna port may be associated with an antenna port number and different physical channels may correspond to different ranges of antenna port numbers.

[0099] FIG. 9 shows an example of time-frequency resource grid in accordance with several of various embodiments of the present disclosure. The number of subcarriers in a carrier bandwidth may be based on the numerology of OFDM transmissions in the carrier. A resource element, corresponding to one symbol duration and one subcarrier, may be the smallest physical resource in the time-frequency grid. A resource element (RE) for antenna port p and subcarrier spacing configuration μ may be uniquely identified by $(k, l)_{p,\mu}$ where k is the index of a subcarrier in the frequency domain and l may refer to the symbol position in the time domain relative to some reference point. A resource block may be defined as $N_{SC}^{RB} = 12$ subcarriers. Since subcarrier spacing depends on the numerology of OFDM transmission, the frequency domain span of a resource block may be variable and may depend on the numerology. For example, for a subcarrier spacing of 15 KHz (e.g., μ=0), a resource block may be 180 KHz and for a subcarrier spacing of 30 KHz (e.g., μ=1), a resource block may be 360 KHz.

[0100] With large carrier bandwidths defined in NR and due to limited capabilities for some UEs (e.g., due to hardware limitations), a UE may not support an entire carrier bandwidth. Receiving on the full carrier bandwidth may imply high energy consumption. For example, transmitting downlink control channels on the full downlink carrier bandwidth may result in high power consumption for wide carrier bandwidths. NR may use a bandwidth adaptation procedure to dynamically adapt the transmit and receive bandwidths. The transmit and receive bandwidth of a UE on a cell may be smaller than the bandwidth of the cell and may be adjusted. For example, the

width of the transmit and/or receive bandwidth may change (e.g. shrink during period of low activity to save power); the location of the transmit and/or receive bandwidth may move in the frequency domain (e.g. to increase scheduling flexibility); and the subcarrier spacing of the transmit or receive bandwidth may change (e.g. to allow different services). A subset of the cell bandwidth may be referred to as a Bandwidth Part (BWP) and bandwidth adaptation may be achieved by configuring the UE with one or more BWPs. The base station may configure a UE with a set of downlink BWPs and a set of uplink BWPs. A BWP may be characterized by a numerology (e.g., subcarrier spacing and cyclic prefix) and a set of consecutive resource blocks in the numerology of the BWP. One or more first BWPs of the one or more BWPs of the cell may be active at a time. An active BWP may be an active downlink BWP or an active uplink BWP.

[0101] FIG. 10 shows an example of bandwidth part adaptation and switching. In this example, three BWPs (BWP_1 1004, BWP_2 1006 and BWP_3 1008) are configured for a UE on a carrier bandwidth. The BWP_1 is configured with a bandwidth of 40 MHz and a numerology with subcarrier spacing of 15 KHz, the BWP_2 is configured with a bandwidth of 10 MHz and a numerology with subcarrier spacing of 15 KHz and the BWP_3 is configured with a bandwidth of 20 MHz and a subcarrier spacing of 60 KHz. The wireless device may switch from a first BWP (e.g., BWP_1) to a second BWP (e.g., BWP_2). An active BWP of the cell may change from the first BWP to the second BWP in response to the BWP switching.

[0102] The BWP switching (e.g., BWP switching 1010, BWP switching 1012, BWP switching 1014, or BWP switching 1016 in FIG. 10) may be based on a command from the base station. The command may be a DCI comprising scheduling information for the UE in the second BWP. In case of uplink BWP switching, the first BWP and the second BWP may be uplink BWPs and the scheduling information may be an uplink grant for uplink transmission via the second BWP. In case of downlink BWP switching, the first BWP and the second BWP may be downlink BWPs and the scheduling information may be a downlink assignment for downlink reception via the second BWP.

[0103] The BWP switching (e.g., BWP switching 1010, BWP switching 1012, BWP switching 1014, or BWP switching 1016 in FIG. 10) may be based on an expiry of a timer. The base station may configure a wireless device with a BWP inactivity timer and the wireless device may switch to a default BWP (e.g., default downlink BWP) based on the expiry of the BWP inactivity timer. The expiry of the BWP inactivity timer may be an indication of low activity on the current active downlink BWP. The base station may configure the wireless device with the default downlink

BWP. If the base station does not configure the wireless device with the default BWP, the default BWP may be an initial downlink BWP. The initial active BWP may be the BWP that the wireless device receives scheduling information for remaining system information upon transition to an RRC_CONNECTED state.

[0104] A wireless device may monitor a downlink control channel of a downlink BWP. For example, the UE may monitor a set of PDCCH candidates in configured monitoring occasions in one or more configured COntrol REsource SETs (CORESETs) according to the corresponding search space configurations. A search space configuration may define how/where to search for PDCCH candidates. For example, the search space configuration parameters may comprise a monitoring periodicity and offset parameter indicating the slots for monitoring the PDCCH candidates. The search space configuration parameters may further comprise a parameter indicating a first symbol with a slot within the slots determined for monitoring PDCCH candidates. A search space may be associated with one or more CORESETs and the search space configuration may indicate one or more identifiers of the one or more CORESETs. The search space configuration parameters may further indicate that whether the search space is a common search space or a UE-specific search space. A common search space may be monitored by a plurality of wireless devices and a UE-specific search space may be dedicated to a specific UE.

[0105] FIG. 11A shows example arrangements of carriers in carrier aggregation in accordance with several of various embodiments of the present disclosure. With carrier aggregation, multiple NR component carriers (CCs) may be aggregated. Downlink transmissions to a wireless device may take place simultaneously on the aggregated downlink CCs resulting in higher downlink data rates. Uplink transmissions from a wireless device may take place simultaneously on the aggregated uplink CCs resulting in higher uplink data rates. The component carriers in carrier aggregation may be on the same frequency band (e.g., intra-band carrier aggregation) or on different frequency bands (e.g., inter-band carrier aggregation). The component carriers may also be contiguous or non-contiguous. This results in three possible carrier aggregation scenarios, intra-band contiguous CA 1102, intra-band non-contiguous CA 1104 and inter-band CA 1106 as shown in FIG. 11A. Depending on the UE capability for carrier aggregation, a UE may transmit and/or receive on multiple carriers or for a UE that is not capable of carrier aggregation, the UE may transmit and/or receive on one component carrier at a time. In this disclosure, the carrier aggregation is described

using the term cell and a carrier aggregation capable UE may transmit and/or receive via multiple cells.

[0106] In carrier aggregation, a UE may be configured with multiple cells. A cell of the multiple cells configured for the UE may be referred to as a Primary Cell (PCell). The PCell may be the first cell that the UE is initially connected to. One or more other cells configured for the UE may be referred to as Secondary Cells (SCells). The base station may configure a UE with multiple SCells. The configured SCells may be deactivated upon configuration and the base station may dynamically activate or deactivate one or more of the configured SCells based on traffic and/or channel conditions. The base station may activate or deactivate configured SCells using a SCell Activation/Deactivation MAC CE. The SCell Activation/Deactivation MAC CE may comprise a bitmap, wherein each bit in the bitmap may correspond to a SCell and the value of the bit indicates an activation status or deactivation status of the SCell.

[0107] An SCell may also be deactivated in response to expiry of a SCell deactivation timer of the SCell. The expiry of an SCell deactivation timer of an SCell may be an indication of low activity (e.g., low transmission or reception activity) on the SCell. The base station may configure the SCell with an SCell deactivation timer. The base station may not configure an SCell deactivation timer for an SCell that is configured with PUCCH (also referred to as a PUCCH SCell). The configuration of the SCell deactivation timer may be per configured SCell and different SCells may be configured with different SCell deactivation timer values. The SCell deactivation timer may be restarted based on one or more criteria including reception of downlink control information on the SCell indicating uplink grant or downlink assignment for the SCell or reception of downlink control information on a scheduling cell indicating uplink grant or downlink assignment for the SCell or transmission of a MAC PDU based on a configured uplink grant or reception of a configured downlink assignment.

[0108] A PCell for a UE may be an SCell for another UE and a SCell for a UE may be PCell for another UE. The configuration of PCell may be UE-specific. One or more SCells of the multiple SCells configured for a UE may be configured as downlink-only SCells, e.g., may only be used for downlink reception and may not be used for uplink transmission. In case of self-scheduling, the base station may transmit signaling for uplink grants and/or downlink assignments on the same cell that the corresponding uplink or downlink transmission takes place. In case of cross-carrier

scheduling, the base station may transmit signaling for uplink grants and/or downlink assignments on a cell different from the cell that the corresponding uplink or downlink transmission takes place.

[0109] FIG. 11B shows examples of uplink control channel groups in accordance with several of various embodiments of the present disclosure. A base station may configure a UE with multiple PUCCH groups wherein a PUCCH group comprises one or more cells. For example, as shown in FIG. 11B, the base station may configure a UE with a primary PUCCH group 1114 and a secondary PUCCH group 1116. The primary PUCCH group may comprise the PCell 1110 and one or more first SCells. First UCI corresponding to the PCell and the one or more first SCells of the primary PUCCH group may be transmitted by the PUCCH of the PCell. The first UCI may be, for example, HARQ feedback for downlink transmissions via downlink CCs of the PCell and the one or more first SCells. The secondary PUCCH group may comprise a PUCCH SCell and one or more second SCells. Second UCI corresponding to the PUCCH SCell and the one or more second SCells of the secondary PUCCH group may be transmitted by the PUCCH of the PUCCH SCell. The second UCI may be, for example, HARQ feedback for downlink transmissions via downlink CCs of the PUCCH SCell and the one or more second SCells.

[0110] FIG. 12A, FIG. 12B and FIG. 12C show example random access processes in accordance with several of various embodiments of the present disclosure. FIG. 12A shows an example of four step contention-based random access (CBRA) procedure. The four-step CBRA procedure includes exchanging four messages between a UE and a base station. Msg1 may be for transmission (or retransmission) of a random access preamble by the wireless device to the base station. Msg2 may be the random access response (RAR) by the base station to the wireless device. Msg3 is the scheduled transmission based on an uplink grant indicated in Msg2 and Msg4 may be for contention resolution.

[0111] The base station may transmit one or more RRC messages comprising configuration parameters of the random access parameters. The random access parameters may indicate radio resources (e.g., time-frequency resources) for transmission of the random access preamble (e.g., Msg1), configuration index, one or more parameters for determining the power of the random access preamble (e.g., a power ramping parameter, a preamble received target power, etc.), a parameter indicating maximum number of preamble transmission, RAR window for monitoring RAR, cell-specific random access parameters and UE specific random access parameters. The UE-specific random access parameters may indicate one or more PRACH occasions for random access

preamble (e.g., Msg1) transmissions. The random access parameters may indicate association between the PRACH occasions and one or more reference signals (e.g., SSB or CSI-RS). The random access parameters may further indicate association between the random access preambles and one or more reference signals (e.g., SBB or CSI-RS). The UE may use one or more reference signals (e.g., SSB(s) or CSI-RS(s)) and may determine a random access preamble to use for Msg1 transmission based on the association between the random access preambles and the one or more reference signals. The UE may use one or more reference signals (e.g., SSB(s) or CSI-RS(s)) and may determine the PRACH occasion to use for Msg1 transmission based on the association between the PRACH occasions and the reference signals. The UE may perform a retransmission of the random access preamble if no response is received with the RAR window following the transmission of the preamble. UE may use a higher transmission power for retransmission of the preamble. UE may determine the higher transmission power of the preamble based on the power ramping parameter.

[0112] Msg2 is for transmission of RAR by the base station. Msg2 may comprise a plurality of RARs corresponding to a plurality of random access preambles transmitted by a plurality of UEs. Msg2 may be associated with a random access temporary radio identifier (RA-RNTI) and may be received in a common search space of the UE. The RA-RNTI may be based on the PRACH occasion (e.g., time and frequency resources of a PRACH) in which a random access preamble is transmitted. RAR may comprise a timing advance command for uplink timing adjustment at the UE, an uplink grant for transmission of Msg3 and a temporary C-RNTI. In response to the successful reception of Msg2, the UE may transmit the Msg3. Msg3 and Msg4 may enable contention resolution in case of CBRA. In a CBRA, a plurality of UEs may transmit the same random access preamble and may consider the same RAR as being corresponding to them. UE may include a device identifier in Msg3 (e.g., a C-RNTI, temporary C-RNTI or other UE identity). Base station may transmit the Msg4 with a PDSCH and UE may assume that the contention resolution is successful in response to the PDSCH used for transmission of Msg4 being associated with the UE identifier included in Msg3.

[0113] FIG. 12B shows an example of a contention-free random access (CFRA) process. Msg 1 (random access preamble) and Msg 2 (random access response) in FIG. 12B for CFRA may be analogous to Msg 1 and Msg 2 in FIG. 12A for CBRA. In an example, the CFRA procedure may be initiated in response to a PDCCH order from a base station. The PDCCH order for initiating the

CFRA procedure by the wireless device may be based on a DCI having a first format (e.g., format 1_0). The DCI for the PDCCH order may comprise a random access preamble index, an UL/SUL indicator indicating an uplink carrier of a cell (e.g., normal uplink carrier or supplementary uplink carrier) for transmission of the random access preamble, a SS/PBCH index indicating the SS/PBCH that may be used to determine a RACH occasion for PRACH transmission, a PRACH mask index indicating the RACH occasion associated with the SS/PBCH indicated by the SS/PBCH index for PRACH transmission, etc. In an example, the CFRA process may be started in response to a beam failure recovery process. The wireless device may start the CFRA for the beam failure recovery without a command (e.g., PDCCH order) from the base station and by using the wireless device dedicated resources.

[0114] FIG. 12C shows an example of a two-step random access process comprising two messages exchanged between a wireless device and a base station. Msg A may be transmitted by the wireless device to the base station and may comprise one or more transmissions of a preamble and/or one or more transmissions of a transport block. The transport block in Msg A and Msg 3 in FIG. 12A may have similar and/or equivalent contents. The transport block of Msg A may comprise data and control information (e.g., SR, HARQ feedback, etc.). In response to the transmission of Msg A, the wireless device may receive Msg B from the base station. Msg B in FIG. 12C and Msg 2 (e.g., RAR) illustrated in FIGS. 12A and 12B may have similar and/or equivalent content.

[0115] The base station may periodically transmit synchronization signals (SSs), e.g., primary SS (PSS) and secondary SS (SSS) along with PBCH on each NR cell. The PSS/SSS together with PBCH is jointly referred to as a SS/PBCH block. The SS/PBCH block enables a wireless device to find a cell when entering to the mobile communications network or find new cells when moving within the network. The SS/PBCH block spans four OFDM symbols in time domain. The PSS is transmitted in the first symbol and occupies 127 subcarriers in frequency domain. The SSS is transmitted in the third OFDM symbol and occupies the same 127 subcarriers as the PSS. The are eight and nine empty subcarriers on each side of the SSS. The PBCH is transmitted on the second OFDM symbol occupying 240 subcarriers, the third OFDM symbol occupying 48 subcarriers on each side of the SSS, and on the fourth OFDM symbol occupying 240 subcarriers. Some of the PBCH resources indicated above may be used for transmission of the demodulation reference signal (DMRS) for coherent demodulation of the PBCH. The SS/PBCH block is transmitted periodically with a period ranging from 5 ms to 160 ms. For initial cell search or for cell search

during inactive/idle state, a wireless device may assume that that the SS/PBCH block is repeated at least every 20 ms.

[0116] In NR, transmissions using of antenna arrays, with many antenna elements, and beamforming plays an important role specially in higher frequency bands. Beamforming enables higher capacity by increasing the signal strength (e.g., by focusing the signal energy in a specific direction) and by lowering the amount interference received at the wireless devices. The beamforming techniques may generally be divided to analog beamforming and digital beamforming techniques. With digital beamforming, signal processing for beamforming is carried out in the digital domain before digital-to-analog conversion and detailed control of both amplitude and phase of different antenna elements may be possible. With analog beamforming, the signal processing for beamforming is carried out in the analog domain and after the digital to analog conversion. The beamformed transmissions may be in one direction at a time. For example, the wireless devices that are in different directions relative to the base station may receive their downlink transmissions at different times. For analog receiver-side beamforming, the receiver may focus its receiver beam in one direction at a time.

[0117] In NR, the base station may use beam sweeping for transmission of SS/PBCH blocks. The SS/PBCH blocks may be transmitted in different beams using time multiplexing. The set of SS/PBCH blocks that are transmitted in one beam sweep may be referred to as a SS/PBCH block set. The period of PBCH/SSB block transmission may be a time duration between a SS/PBCH block transmission in a beam and the next SS/PBCH block transmission in the same beam. The period of SS/PBCH block is, therefore, also the period of the SS/PBCH block set.

[0118] FIG. 13A shows example time and frequency structure of SS/PBCH blocks and their associations with beams in accordance with several of various embodiments of the present disclosure. In this example, a SS/PBCH block (also referred to as SSB) set comprise L SSBs wherein an SSB in the SSB set is associated with (e.g., transmitted in) one of L beams of a cell. The transmission of SBBs of an SSB set may be confined within a 5ms interval, either in a first half-frame or a second half-frame of a 10ms frame. The number of SSBs in an SSB set may depend on the frequency band of operation. For example, the number of SSBs in a SSB set may be up to four SSBs in frequency bands below 3GHz enabling beam sweeping of up to four beams, up to eight SSBs in frequency bands between 3 GHz and 6 GHz enabling beam sweeping of up to eight beams, and up to sixty four SSBs in higher frequency bands enabling beam sweeping of up to sixty four

beams. The SSs of an SSB may depend on a physical cell identity (PCI) of the cell and may be independent of which beam of the cell is used for transmission of the SSB. The PBCH of an SSB may indicate a time index parameter and the wireless device may determine the relative position of the SSB within the SSB set using the time index parameter. The wireless device may use the relative position of the SSB within an SSB set for determining the frame timing and/or determining RACH occasions for a random access process.

[0119] A wireless device entering the mobile communications network may first search for the PSS. After detecting the PSS, the wireless device may determine the synchronization up to the periodicity of the PSS. By detecting the PSS, the wireless device may determine the transmission timing of the SSS. The wireless device may determine the PCI of the cell after detecting the SSS. The PBCH of a SS/PBCH block is a downlink physical channel that carries the MIB. The MIB may be used by the wireless device to obtain remaining system information (RMSI) that is broadcast by the network. The RMSI may include System Information Block 1 (SIB1) that contains information required for the wireless device to access the cell.

[0120] As discussed earlier, the wireless device may determine a time index parameter from the SSB. The PBCH comprises a half-frame parameter indicating whether the SSB is in the first 5ms half or the second 5ms half of a 10ms frame. The wireless device may determine the frame boundary using the time index parameter and the half-frame parameter. In addition, the PBCH may comprise a parameter indicating the system frame number (SFN) of the cell.

[0121] The base station may transmit CSI-RS and a UE may measure the CSI-RS to obtain channel state information (CSI). The base station may configure the CSI-RS in a UE-specific manner. In some scenarios, same set of CSI-RS resources may be configured for multiple UEs and one or more resource elements of a CSI-RS resource may be shared among multiple UEs. A CSI-RS resource may be configured such that it does not collide with a CORESET configured for the wireless device and/or with a DMRS of a PDSCH scheduled for the wireless device and/or transmitted SSBs. The UE may measure one or more CSI-RSs configured for the UE and may generate a CSI report based on the CSI-RS measurements and may transmit the CSI report to the base station for scheduling, link adaptation and/or other purposes.

[0122] NR supports flexible CSI-RS configurations. A CSI-RS resource may be configured with single or multiple antenna ports and with configurable density. Based on the number of configured antenna ports, a CSI-RS resource may span different number of OFDM symbols (e.g., 1, 2, and 4

symbols). The CSI-RS may be configured for a downlink BWP and may use the numerology of the downlink BWP. The CSI-RS may be configured to cover the full bandwidth of the downlink BWP or a portion of the downlink BWP. In some case, the CSI-RS may be repeated in every resource block of the CSI-RS bandwidth, referred to as CSI-RS with density equal to one. In some cases, the CSI-RS may be configured to be repeated in every other resource block of the CSI-RS bandwidth. CSI-RS may be non-zero power (NZP) CSI-RS or zero-power (ZP) CSI-RS.

[0123] The base station may configure a wireless device with one or more sets of NZP CSI-RS resources. The base station may configure the wireless device with a NZP CSI-RS resource set using an RRC information element (IE) NZP-CSI-RS-ResourceSet indicating a NZP CSI-RS resource set identifier (ID) and parameters specific to the NZP CSI-RS resource set. An NZP CSI-RS resource set may comprise one or more CSI-RS resources. An NZP CSI-RS resource set may be configured as part of the CSI measurement configuration.

[0124] The CSI-RS may be configured for periodic, semi-persistent or aperiodic transmission. In case of the periodic and semi-persistent CSI-RS configurations, the wireless device may be configured with a CSI resource periodicity and offset parameter that indicate a periodicity and corresponding offset in terms of number of slots. The wireless device may determine the slots that the CSI-RSs are transmitted. For semi-persistent CSI-RS, the CSI-RS resources for CSI-RS transmissions may be activated and deactivated by using a semi-persistent (SP) CSI-CSI Resource Set Activation/Deactivation MAC CE. In response to receiving a MAC CE indicating activation of semi-persistent CSI-RS resources, the wireless device may assume that the CSI-RS transmissions will continue until the CSI-RS resources for CSI-RS transmissions are activated.

[0125] As discussed before, CSI-RS may be configured for a wireless device as NZP CSI-RS or ZP CSI-RS. The configuration of the ZP CSI-RS may be similar to the NZP CSI-RS with the difference that the wireless device may not carry out measurements for the ZP CSI-RS. By configuring ZP CSI-RS, the wireless device may assume that a scheduled PDSCH that includes resource elements from the ZP CSI-RS is rate matched around those ZP CSI-RS resources. For example, a ZP CSI-RS resource configured for a wireless device may be an NZP CSI-RS resource for another wireless device. For example, by configuring ZP CSI-RS resources for the wireless device, the base station may indicate to the wireless device that the PDSCH scheduled for the wireless device is rate matched around the ZP CSI-RS resources.

[0126] A base station may configure a wireless device with channel state information interference measurement (CSI-IM) resources. Similar to the CSI-RS configuration, configuration of locations and density of CSI-IM resources may be flexible. The CSI-IM resources may be periodic (configured with a periodicity), semi-persistent (configured with a periodicity and activated and deactivated by MAC CE) or aperiodic (triggered by a DCI).

[0127] Tracking reference signals (TRSs) may be configured for a wireless device as a set of sparse reference signals to assist the wireless in time and frequency tracking and compensating time and frequency variations in its local oscillator. The wireless device may further use the TRSs for estimating channel characteristics such as delay spread or doppler frequency. The base station may use a CSI-RS configuration for configuring TRS for the wireless device. The TRS may be configured as a resource set comprising multiple periodic NZP CSI-RS resources.

[0128] A base station may configure a UE and the UE may transmit sounding reference signals (SRSs) to enable uplink channel sounding/estimation at the base station. The SRS may support up to four antenna ports and may be designed with low cubic metric enabling efficient operation of the wireless device amplifier. The SRS may span one or more (e.g., one, two or four) consecutive OFDM symbols in time domain and may be located within the last n (e.g., six) symbols of a slot. In the frequency domain, the SRS may have a structure that is referred to as a comb structure and may be transmitted on every Nth subcarrier. Different SRS transmissions from different wireless devices may have different comb structures and may be multiplexed in frequency domain.

[0129] A base station may configure a wireless device with one or more SRS resource sets and an SRS resource set may comprise one or more SRS resources. The SRS resources in an SRS resources set may be configured for periodic, semi-persistent or aperiodic transmission. The periodic SRS and the semi-persistent SRS resources may be configured with periodicity and offset parameters. The Semi-persistent SRS resources of a configured semi-persistent SRS resource set may be activated or deactivated by a semi-persistent (SP) SRS Activation/Deactivation MAC CE. The set of SRS resources included in an aperiodic SRS resource set may be activated by a DCI. A value of a field (e.g., an SRS request field) in the DCI may indicate activation of resources in an aperiodic SRS resource set from a plurality of SRS resource sets configured for the wireless device.

[0130] An antenna port may be associated with one or more reference signals. The receiver may assume that the one or more reference signals, associated with the antenna port, may be used for estimating channel corresponding to the antenna port. The reference signals may be used to derive

channel state information related to the antenna port. Two antenna ports may be referred to as quasi co-located if characteristics (e.g., large-scale properties) of the channel over which a symbol is conveyed on one antenna port may be inferred from the channel over which a symbol is conveyed from another antenna port. For example, a UE may assume that radio channels corresponding to two different antenna ports have the same large-scale properties if the antenna ports are specified as quasi co-located. In some cases, the UE may assume that two antenna ports are quasi co-located based on signaling received from the base station. Spatial quasi-colocation (QCL) between two signals may be, for example, due to the two signals being transmitted from the same location and in the same beam. If a receive beam is good for a signal in a group of signals that are spatially quasi co-located, it may be assumed also be good for the other signals in the group of signals.

[0131] The CSI-RS in the downlink and the SRS in uplink may serve as quasi-location (QCL) reference for other physical downlink channels and physical uplink channels, respectively. For example, a downlink physical channel (e.g., PDSCH or PDCCH) may be spatially quasi co-located with a downlink reference signal (e.g., CSI-RS or SSB). The wireless device may determine a receive beam based on measurement on the downlink reference signal and may assume that the determined received beam is also good for reception of the physical channels (e.g., PDSCH or PDCCH) that are spatially quasi co-located with the downlink reference signal. Similarly, an uplink physical channel (e.g., PUSCH or PUCCH) may be spatially quasi co-located with an uplink reference signal (e.g., SRS). The base station may determine a receive beam based on measurement on the uplink reference signal and may assume that the determined received beam is also good for reception of the physical channels (e.g., PUSCH or PUCCH) that are spatially quasi co-located with the uplink reference signal.

[0132] The Demodulation Reference Signals (DM-RSs) enables channel estimation for coherent demodulation of downlink physical channels (e.g., PDSCH, PDCCH and PBH) and uplink physical channels (e.g., PUSCH and PUCCH). The DM-RS may be located early in the transmission (e.g., front-loaded DM-RS) and may enable the receiver to obtain the channel estimate early and reduce the latency. The time-domain structure of the DM-RS (e.g., symbols wherein the DM-RS are located in a slot) may be based on different mapping types.

[0133] The Phase Tracking Reference Signals (PT-RSs) enables tracking and compensation of phase variations across the transmission duration. The phase variations may be, for example, due to oscillator phase noise. The oscillator phase noise may become more sever in higher frequencies

(e.g., mmWave frequency bands). The base station may configure the PT-RS for uplink and/or downlink. The PT-RS configuration parameters may indicate frequency and time density of PT-RS, maximum number of ports (e.g., uplink ports), resource element offset, configuration of uplink PT-RS without transform precoder (e.g., CP-OFDM) or with transform precoder (e.g., DFT-s-OFDM), etc. The subcarrier number and/or resource blocks used for PT-RS transmission may be based on the C-RNTI of the wireless device to reduce risk of collisions between PT-RSs of wireless devices scheduled on overlapping frequency domain resources.

[0134] FIG. 13B shows example time and frequency structure of CSI-RSs and their association with beams in accordance with several of various embodiments of the present disclosure. A beam of the L beams shown in FIG. 13B may be associated with a corresponding CSI-RS resource. The base station may transmit the CSI-RSs using the configured CSI-RS resources and a UE may measure the CSI-RSs (e.g., received signal received power (RSRP) of the CSI-RSs) and report the CSI-RS measurements to the base station based on a reporting configuration. For example, the base station may determine one or more transmission configuration indication (TCI) states and may indicate the one or more TCI states to the UE (e.g., using RRC signaling, a MAC CE and/or a DCI). Based on the one or more TCI states indicated to the UE, the UE may determine a downlink receive beam and receive downlink transmissions using the receive beam. In case of a beam correspondence, the UE may determine a spatial domain filter of a transmit beam based on spatial domain filter of a corresponding receive beam. Otherwise, the UE may perform an uplink beam selection procedure to determine the spatial domain filter of the transmit beam. The UE may transmit one or more SRSs using the SRS resources configured for the UE and the base station may measure the SRSs and determine/select the transmit beam for the UE based the SRS measurements. The base station may indicate the selected beam to the UE. The CSI-RS resources shown in FIG. 13B may be for one UE. The base station may configure different CSI-RS resources associated with a given beam for different UEs by using frequency division multiplexing.

[0135] A base station and a wireless device may perform beam management procedures to establish beam pairs (e.g., transmit and receive beams) that jointly provide good connectivity. For example, in the downlink direction, the UE may perform measurements for a beam pair and estimate channel quality for a transmit beam by the base station (or a transmission reception point (TRP) more generally) and the receive beam by the UE. The UE may transmit a report indicating beam pair quality parameters. The report may comprise one or more parameters indicating one or

more beams (e.g., a beam index, an identifier of reference signal associated with a beam, etc.), one or more measurement parameters (e.g., RSRP), a precoding matrix indicator (PMI), a channel quality indicator (CQI), and/or a rank indicator (RI).

[0136] FIG. 14A, FIG. 14B and FIG. 14C show example beam management processes (referred to as P1, P2 and P3, respectively) in accordance with several of various embodiments of the present disclosure. The P1 process shown in FIG. 14A may enable, based on UE measurements, selection of a base station (or TRP more generally) transmit beam and/or a wireless device receive beam. The TRP may perform a beam sweeping procedure where the TRP may sequentially transmit reference signals (e.g., SSB and/or CSI-RS) on a set of beams and the UE may select a beam from the set of beams and may report the selected beam to the TRP. The P2 procedure as shown in FIG. 14B may be a beam refinement procedure. The selection of the TRP transmit beam and the UE receive beam may be regularly reevaluated due to movements and/or rotations of the UE or movement of other objects. In an example, the base station may perform the beam sweeping procedure over a smaller set of beams and the UE may select the best beam over the smaller set. In an example, the beam shape may be narrower compared to beam selected based on the P1 procedure. Using the P3 procedure as shown in FIG. 14C, the TRP may fix its transmit beam and the UE may refine its receive beam.

[0137] A wireless device may receive one or more messages from a base station. The one or more messages may comprise one or more RRC messages. The one or more messages may comprise configuration parameters of a plurality of cells for the wireless device. The plurality of cells may comprise a primary cell and one or more secondary cells. For example, the plurality of cells may be provided by a base station and the wireless device may communicate with the base station using the plurality of cells. For example, the plurality of cells may be provided by multiple base station (e.g., in case of dual and/or multi-connectivity). The wireless device may communicate with a first base station, of the multiple base stations, using one or more first cells of the plurality of cells. The wireless device may communicate with a second base station of the multiple base stations using one or more second cells of the plurality of cells.

[0138] The one or more messages may comprise configuration parameters used for processes in physical, MAC, RLC, PCDP, SDAP, and/or RRC layers of the wireless device. For example, the configuration parameters may include values of timers used in physical, MAC, RLC, PCDP, SDAP, and/or RRC layers. For example, the configuration parameters may include parameters for

configurating different channels (e.g., physical layer channel, logical channels, RLC channels, etc.) and/or signals (e.g., CSI-RS, SRS, etc.).

[0139] Upon starting a timer, the timer may start running until the timer is stopped or until the timer expires. A timer may be restarted if it is running. A timer may be started if it is not running (e.g., after the timer is stopped or after the timer expires). A timer may be configured with or may be associated with a value (e.g., an initial value). The timer may be started or restarted with the value of the timer. The value of the timer may indicate a time duration that the timer may be running upon being started or restarted and until the timer expires. The duration of a timer may not be updated until the timer is stopped or expires (e.g., due to BWP switching). This specification may disclose a process that includes one or more timers. The one or more timers may be implemented in multiple ways. For example, a timer may be used by the wireless device and/or base station to determine a time window [t1, t2], wherein the timer is started at time t1 and expires at time t2 and the wireless device and/or the base station may be interested in and/or monitor the time window [t1, t2], for example to receive a specific signaling. Other examples of implementation of a timer may be provided.

[0140] FIG. 15 shows example components of a wireless device and a base station that are in communication via an air interface in accordance with several of various embodiments of the present disclosure. The wireless device 1502 may communicate with the base station 1542 over the air interface 1532. The wireless device 1502 may include a plurality of antennas. The base station 1542 may include a plurality of antennas. The plurality of antennas at the wireless device 1502 and/or the base station 1542 enables different types of multiple antenna techniques such as beamforming, single-user and/or multi-user MIMO, etc.

[0141] The wireless device 1502 and the base station 1542 may have one or more of a plurality of modules/blocks, for example RF front end (e.g., RF front end 1530 at the wireless device 1502 and RF front end 1570 at the base station 1542), Data Processing System (e.g., Data Processing System1524 at the wireless device 1502 and Data Processing System1564 at the base station 1542), Memory (e.g., Memory 1512 at the wireless device 1502 and Memory 1542 at the base station1542). Additionally, the wireless device 1502 and the base station 1542 may have other modules/blocks such as GPS (e.g., GPS 1514 at the wireless device 1502 and GPS 1554 at the base station 1542).

[0142] An RF front end module/block may include circuitry between antennas and a Data Processing System for proper conversion of signals between these two modules/blocks. An RF front end may include one or more filters (e.g., Filter(s) 1526 at RF front end 1530 or Filter(s) 1566 at the RF front end 1570), one or more amplifiers (e.g., Amplifier(s) 1528 at the RF front end 1530 and Amplifier(s) 1568 at the RF front end 1570). The Amplifier(s) may comprise power amplifier(s) for transmission and low-noise amplifier(s) (LNA(s)) for reception.

[0143] The Data Processing System 1524 and the Data Processing System 1564 may process the data to be transmitted or the received signals by implementing functions at different layers of the protocol stack such as PHY, MAC, RLC, etc. Example PHY layer functions that may be implemented by the Data Processing System1524 and/or 1564 may include forward error correction, interleaving, rate matching, modulation, precoding, resource mapping, MIMO processing, etc. Similarly, one or more functions of the MAC layer, RLC layer and/or other layers may be implemented by the Data Processing System1524 and/or the Data Processing System1564. One or more processes described in the present disclosure may be implemented by the Data Processing System1524 and/or the Data Processing System1564. A Data Processing System may include an RF module (RF module 1516 at the Data Processing System1524 and RF module 1556 at the Data Processing System1564) and/or a TX/RX processor (e.g., TX/RX processor 1518 at the Data Processing System1524 and TX/RX processor 1558 at the Data Processing System1566) and/or a central processing unit (CPU) (e.g., CPU 1520 at the Data Processing System1524 and CPU 1560 at the Data Processing System1564) and/or a graphical processing unit (GPU) (e.g., GPU 1522 at the Data Processing System1524 and GPU 1562 at the Data Processing System1564).

[0144] The Memory 1512 may have interfaces with the Data Processing System 1524 and the Memory 1552 may have interfaces with Data Processing System1564, respectively. The Memory 1512 or the Memory 1552 may include non-transitory computer readable mediums (e.g., Storage Medium 1510 at the Memory 1512 and Storage Medium 1550 at the Memory 1552) that may store software code or instructions that may be executed by the Data Processing System1524 and Data Processing System1564, respectively, to implement the processes described in the present disclosure. The Memory 1512 or the Memory 1552 may include random-access memory (RAM) (e.g., RAM 1506 at the Memory 1512 or RAM 1546 at the Memory 1552) or read-only memory (ROM) (e.g., ROM 1508 at the Memory 1512 or ROM 1548 at the Memory 1552) to store data and/or software codes.

[0145] The Data Processing System1524 and/or the Data Processing System1564 may be connected to other components such as a GPS module 1514 and a GPS module 1554, respectively, wherein the GPS module 1514 and a GPS module 1554 may enable delivery of location information of the wireless device 1502 to the Data Processing System1524 and location information of the base station 1542 to the Data Processing System1564. One or more other peripheral components (e.g., Peripheral Component(s) 1504 or Peripheral Component(s) 1544) may be configured and connected to the data Processing System1524 and data Processing System1564, respectively.

[0146] In example embodiments, a wireless device may be configured with parameters and/or configuration arrangements. For example, the configuration of the wireless device with parameters and/or configuration arrangements may be based on one or more control messages that may be used to configure the wireless device to implement processes and/or actions. The wireless device may be configured with the parameters and/or the configuration arrangements regardless of the wireless device being in operation or not in operation. For example, software, firmware, memory, hardware and/or a combination thereof and/or alike may be configured in a wireless device regardless of the wireless device being in operation or not operation. The configured parameters and/or settings may influence the actions and/or processes performed by the wireless device when in operation.

[0147] In example embodiments, a wireless device may receive one or more message comprising configuration parameters. For example, the one or more messages may comprise radio resource control (RRC) messages. A parameter of the configuration parameters may be in at least one of the one or more messages. The one or more messages may comprise information element (IEs). An information element may be a structural element that includes single or multiple fields. The fields in an IE may be individual contents of the IE. The terms configuration parameter, IE and field may be used equally in this disclosure. The IEs may be implemented using a nested structure, wherein an IE may include one or more other IEs and an IE of the one or more other IEs may include one or more additional IEs. With this structure, a parent IE contains all the offspring IEs as well. For example, a first IE containing a second IE, the second IE containing a third IE, and the third IE containing a fourth IE may imply that the first IE contains the third IE and the fourth IE.

[0148] The amount of licensed spectrum available for an operator to meet the demands may not be sufficient and obtaining licensed spectrum may be costly. Unlicensed spectrum is freely available subject to a set of rules, for example rules on maximum transmission power. Since the unlicensed

spectrum is freely available, the interference situation may be more unpredictable compared to licensed spectrum. Achieving quality-of-service may be more challenging in unlicensed spectrum. WLANs and Bluetooth are examples of communication systems exploiting unlicensed spectrum in the lower-frequency range, e.g., 2.4 GHz or 5 GHz.

[0149] Some of the frequency bands used by an NR communications system may be unlicensed (e.g., in lower and/or higher frequency bands). Different deployment scenarios may be used in example embodiments. Example deployment scenarios include: carrier aggregation between licensed band NR (for example for PCell) and unlicensed band NR (NR-U) (for example for SCell), wherein NR-U SCell may have both DL and UL or may be DL-only; dual connectivity between licensed band LTE (e.g., PCell) and NR-U (e.g., PSCell); standalone NR-U, wherein PCell and SCell may be both in unlicensed bands; an NR cell with DL in unlicensed band and UL in licensed band; and dual connectivity between licensed band NR (e.g., PCell) and NR-U (e.g., PSCell).

[0150] In an example, the licensed spectrum may be used to provide wide-area coverage and quality-of-service guarantees, with unlicensed spectrum used as a local-area complement to increase user data rates and overall capacity without compromising on overall coverage, availability, and reliability. This may be referred to as License-Assisted Access (LAA).

[0151] In an example, to enable fair sharing of unlicensed spectra with other operators and/or systems (e.g., Wi-Fi), several mechanisms may be used in example embodiments. Example mechanisms may include dynamic frequency selection (DFS), where a network node may search and find a part of the unlicensed spectrum with low load. Example embodiments may employ listen-before-talk (LBT) based on example channel access procedures, where the transmitter ensures there are no ongoing transmissions on the carrier frequency prior to transmitting.

[0152] In an example, a channel may refer to a carrier or a part of a carrier on which a channel access procedure is performed. A channel access procedure is a procedure based on sensing that evaluates the availability of a channel for performing transmissions on. The basic unit for sensing may be a sensing slot with a duration $T_{sl} = 9us$. The sensing slot duration T_{sl} may be considered to be idle if a base station or a wireless device senses the channel during the sensing slot duration, and determines that the detected power for at least a portion (e.g., $4us$) within the sensing slot duration is less than an energy detection threshold (e.g., X_{Thresh}). Otherwise, the sensing slot duration T_{sl} may be considered to be busy.

[0153] A Channel Occupancy Time (COT) may refer to the total time for which eNB/gNB/UE and eNB/gNB/UEs sharing the channel occupancy can perform transmission(s) on a channel after an eNB/gNB/UE performs the corresponding channel access procedures. For determining a Channel Occupancy Time, if a transmission gap is less than 25us, the gap duration may be counted in the channel occupancy time. A channel occupancy time may be shared for transmission between a base station and the corresponding wireless device(s). A DL transmission burst may be defined as a set of transmissions from a base station without gaps greater than 16 us. Transmissions from a base station separated by a gap of more than 16 us may be considered as separate DL transmission bursts. An UL transmission burst may be defined as a set of transmissions from a UE without gaps greater than 16 us. Transmissions from a wireless device separated by a gap of more than 16 us may be considered as separate UL transmission.

[0154] In an example, a wireless device may access a channel on which uplink transmission(s) are performed according to an uplink channel access procedure (e.g., one of Type 1 or Type 2 uplink channel access procedures). If an uplink grant scheduling a PUSCH transmission indicates Type 1 channel access procedure, the wireless device may use Type 1 channel access procedure for transmitting transmissions including the PUSCH transmission. A wireless device may use Type 1 channel access procedure for transmitting transmissions including autonomous PUSCH transmission on configured uplink resources. If an uplink grant scheduling a PUSCH transmission indicates Type 2 channel access procedure, the wireless device may use Type 2 channel access procedure for transmitting transmissions including the PUSCH transmission. A wireless device may use Type 1 channel access procedure for transmitting SRS transmissions not including a PUSCH transmission. In an example, uplink channel access priority class p =1, as shown in FIG. 16, may be used for SRS transmissions not including a PUSCH.

[0155] In an example, if a wireless device is scheduled by a base station to transmit PUSCH and SRS in contiguous transmissions without gaps in between, and if the wireless device cannot access the channel for PUSCH transmission, the wireless device may attempt to make SRS transmission according to uplink channel access procedures for SRS transmission.

[0156] In an example, a wireless device may use Type 1 channel access procedure for PUCCH only transmissions or PUSCH only transmissions without UL-SCH with UL channel access priority class p =1 in FIG. 16.

[0157] In an example, a wireless device may use Type 1 channel access procedure for transmissions related to random access procedure with uplink channel access priority class p =1 in FIG. 16.

[0158] In an example, the total duration of autonomous uplink transmission(s) obtained by the channel access procedure, including the following DL transmission if the UE sets 'COT sharing indication' in AUL-UCI to '1' in a subframe within the autonomous uplink transmission(s), may not exceed $T_{ulmcot,p}$, where $T_{ulmcot,p}$ is given in FIG. 16.

[0159] In an example, a wireless device may detect 'UL duration and offset' field in a DCI. If the UL duration and offset' field indicates an 'UL offset' l and an 'UL duration' d for subframe n, then the scheduled UE may use channel access Type 2 for transmissions in subframes $n + l + i$ where $i = 0,1, \dots d - 1$, irrespective of the channel access Type signalled in the UL grant for those subframes, if the end of wireless device transmission occurs in or before subframe $n + l + d - 1$.

[0160] In an example, if the 'UL duration and offset' field indicates an 'UL offset' l and an 'UL duration' d for subframe n and the 'COT sharing indication for AUL' field is set to '1', a UE configured with autonomous UL may use channel access Type 2 for autonomous UL transmissions corresponding to any priority class in subframes $n + l + i$ where $i = 0,1, \dots d - 1$, if the end of wireless device autonomous UL transmission occurs in or before subframe $n + l + d - 1$ and the autonomous UL transmission between $n + l$ and $n + l + d - 1$ may be contiguous.

[0161] In an example, if the 'UL duration and offset' field indicates an 'UL offset' l and an 'UL duration'd for subframe n and the 'COT sharing indication for AUL' field is set to '0', then a UE configured with autonomous UL may not transmit autonomous UL in subframes $n + l + i$ where $i = 0,1, \dots d - 1$.

[0162] In an example, for contiguous UL transmission(s), if a wireless device is scheduled to transmit a set of w UL transmissions including PUSCH using a PDCCH DCI format, and if the wireless device cannot access the channel for a transmission in the set prior to the last transmission, the wireless device may attempt to transmit the next transmission according to the channel access type indicated in the DCI.

[0163] In an example, for contiguous uplink transmission(s), if a wireless device is scheduled to transmit a set of w consecutive uplink transmissions without gaps including PUSCH using one or more PDCCH DCI formats and the wireless device transmits one of the scheduled uplink transmissions in the set after accessing the channel according to one of uplink channel access

procedures (e.g., Type 1 or Type 2), the wireless device may continue transmission the remaining uplink transmissions in the set, if any.

[0164] In an example, for contiguous UL transmission(s), a wireless device may not be expected to be indicated with different channel access types for any consecutive UL transmissions without gaps in between the transmissions.

[0165] In an example, for uplink transmission(s) with multiple starting positions scheduled by a base station, if a wireless device is scheduled by an base station to transmit transmissions including PUSCH Mode 1 using the Type 1 channel access procedure indicated in DCI, and if the wireless device cannot access the channel for a transmission according to the PUSCH starting position indicated in the DCI, the wireless device may attempt to make a transmission at symbol 7 in the same subframe according to Type 1 channel access procedure. In an example, there may be no limit on the number of attempts the UE can make using Type 1 channel access procedure.

[0166] In an example, for uplink transmission(s) with multiple starting positions scheduled by a base station, if a wireless device is scheduled by a base station to transmit transmissions including PUSCH Mode 1 using the Type 2 channel access procedure indicated in DCI, and if the wireless device cannot access the channel for a transmission according to the PUSCH starting position indicated in the DCI, the wireless device may attempt to make a transmission at symbol 7 in the same subframe and according to Type 2 channel access procedure. The number of attempts the wireless device may make within the consecutively scheduled subframes including the transmission may be limited to $w + 1$, where w may be the number of consecutively scheduled subframes using Type 2 channel access procedure.

[0167] In an example, for contiguous uplink transmissions(s) including a transmission pause, if the wireless is scheduled to transmit a set of w consecutive uplink transmissions without gaps using one or more PDCCH DCI formats, and if the wireless device has stopped transmitting during or before of one of these uplink transmissions in the set and prior to the last uplink transmission in the set, and if the channel is sensed by the wireless device to be continuously idle after the wireless device has stopped transmitting, the wireless device may transmit a later uplink transmission in the set using Type 2 channel access procedure. If the channel sensed by the wireless device is not continuously idle after the wireless device has stopped transmitting, the wireless device may transmit a later uplink transmission in the set using Type 1 channel access procedure with the uplink channel access priority class indicated in the DCI corresponding to the uplink transmission.

[0168] In an example, for uplink transmission(s) following configured uplink transmission(s), if the wireless device is scheduled by a base station to transmit on channel c_i by a uplink grant received on channel c_j, $i \neq j$, and if the wireless device is transmitting using autonomous uplink on channel c_i, the wireless device may terminate the ongoing PUSCH transmissions using the autonomous uplink at least one subframe before the uplink transmission according to the received uplink grant.

[0169] In an example, if the wireless device is scheduled by an uplink grant received from a base station on a channel to transmit a PUSCH transmission(s) starting from subframe n on the same channel using Type 1 channel access procedure and if at least for the first scheduled subframe occupies $N_{\mathrm{RB}}^{\mathrm{UL}}$ resource blocks and the indicated 'PUSCH starting position is OFDM symbol zero, and if the wireless device starts autonomous uplink transmissions before subframe n using Type 1 channel access procedure on the same channel, the wireless device may transmit uplink transmission(s) according to the received uplink grant from subframe n without a gap, if the priority class value of the performed channel access procedure is larger than or equal to priority class value indicated in the uplink grant, and the autonomous uplink transmission in the subframe preceding subframe n may end at the last OFDM symbol of the subframe regardless of the higher layer parameter endingSymbolAUL. The sum of the lengths of the autonomous uplink transmission(s) and the scheduled uplink transmission(s) may not exceed the maximum channel occupancy time corresponding to the priority class value used to perform the autonomous uplink channel access procedure. Otherwise, the wireless device may terminate the ongoing autonomous uplink transmission at least one subframe before the start of the uplink transmission according to the received uplink grant on the same channel.

[0170] In an example, if a wireless device receives an uplink grant and a DCI indicating a PUSCH transmission using Type 1 channel access procedure, and if the wireless device has an ongoing Type 1 channel access procedure before the PUSCH transmission starting time, if the uplink channel access priority class value p_1 used for the ongoing Type 1 channel access procedure is same or larger than the uplink channel access priority class value p_2 indicated in the DCI, the wireless device may transmit the PUSCH transmission in response to the uplink grant by accessing the channel by using the ongoing Type 1 channel access procedure.

[0171] In an example, if a wireless device receives an uplink grant and a DCI indicating a PUSCH transmission using Type 1 channel access procedure, and if the wireless device has an ongoing Type 1 channel access procedure before the PUSCH transmission starting time, if the uplink

channel access priority class value p_1 used for the ongoing Type 1 channel access procedure is smaller than the uplink channel access priority class value p_2 indicated in the DCI, the wireless device may terminate the ongoing channel access procedure.

[0172] In an example, a base station may indicate Type 2 channel access procedure in the DCI of an uplink grant scheduling transmission(s) including PUSCH on a channel when: the base station has transmitted on the channel according to a channel access procedure; or base station may indicate using the 'UL duration and offset' field that the wireless device may perform a Type 2 channel access procedure for transmissions(s) including PUSCH on a channel in subframe n when the base station has transmitted on the channel according to a channel access procedure described; or a base station may indicate using the 'UL duration and offset' field and 'COT sharing indication for AUL' field that a wireless device configured with autonomous uplink may perform a Type 2 channel access procedure for autonomous uplink transmissions(s) including PUSCH on a channel in subframe n when the base station has transmitted on the channel according to a channel access procedure and acquired the channel using the largest priority class value and the base station transmission includes PDSCH, or a base station may schedule uplink transmissions on a channel, that follows a transmission by the base station on that channel with a duration of $T_{\text{short_ul}} = 25us$, if the uplink transmissions occurs within the time interval starting at $t_0$and ending at $t_0 + T_{CO}$, where $T_{CO} = T_{m\,cot,p} + T_g$, where t_0 is the time instant when the base station has started transmission, $T_{m\,cot,p}$value is determined by the base station, T_g is the total duration of all gaps of duration greater than 25us that occur between the DL transmission of the base station and uplink transmissions scheduled by the base station, and between any two uplink transmissions scheduled by the base station starting from t_0.

[0173] In an example, the base station may schedule uplink transmissions between t_0 and $t_0 + T_{CO}$ without gaps between consecutive uplink transmissions if they can be scheduled contiguously. For an uplink transmission on a channel that follows a transmission by the base station on that channel within a duration of $T_{\text{short_ul}} = 25us$, the wireless device may use Type 2A channel access procedure for the UL transmission.

[0174] In an example, if the base station indicates Type 2 channel access procedure for the wireless device in the DCI, the base station may indicate the channel access priority class used to obtain access to the channel in the DCI.

[0175] For indicating a Type 2 channel access procedure, if the gap is at least 25us, or 16us, or up to 16us, the base station may indicate Type 2A, or Type 2B, or Type 2C uplink channel procedures, respectively.

[0176] In an example, if a wireless device is scheduled to transmit on a set of channels C, and if Type 1 channel access procedure is indicated by the uplink scheduling grants for the uplink transmissions on the set of channels C, and if the uplink transmissions are scheduled to start transmissions at the same time on all channels in the set of channels C ; or if the wireless device intends to perform an autonomous uplink transmission on configured resources on the set of channels C with Type 1 channel access procedure, and if UL transmissions are configured to start transmissions on the same time all channels in the set of channels C; and if the channel frequencies of set of channels C is a subset of one of the sets of channel frequencies , the wireless device may transmit on channel $c_i \in C$ using Type 2 channel access procedure, if Type 2 channel access procedure is performed on channel c_i immediately before the wireless device transmission on channel $c_j \in C$, $i \neq j$, and if the wireless device has accessed channel c_j using Type 1 channel access procedure, where channel c_j is selected by the wireless device uniformly randomly from the set of channels C before performing Type 1 channel access procedure on any channel in the set of channels C and the wireless device may not transmit on channel $c_i \in C$ within the bandwidth of a carrier, if the wireless device fails to access any of the channels, of the carrier bandwidth, on which the wireless device is scheduled or configured by UL resources.

[0177] In an example, a wireless device may transmit the transmission using Type 1 channel access procedure after first sensing the channel to be idle during the slot durations of a defer duration T_d; and after the counter $N$is zero in step 4. The counter N may be adjusted by sensing the channel for additional slot duration(s) according to the actions described below:

1) set $N = N_{init}$, where N_{init} is a random number uniformly distributed between 0 and CW_p, and go to action 4;

2) if $N > 0$ and the UE chooses to decrement the counter, set $N = N - 1$;

3) sense the channel for an additional slot duration, and if the additional slot duration is idle, go to action 4; else, go to action 5;

4) if $N = 0$, stop; else, go to action 2.

5) sense the channel until either a busy slot is detected within an additional defer duration T_d or all the slots of the additional defer duration T_d are detected to be idle;

6) if the channel is sensed to be idle during all the slot durations of the additional defer duration T_d, go to action 4; else, go to action 5;

[0178] In an example, if a wireless device has not transmitted an uplink transmission on a channel on which uplink transmission(s) are performed after action 4 in the process above, the wireless device may transmit a transmission on the channel, if the channel is sensed to be idle at least in a sensing slot duration T_{sl} when the UE is ready to transmit the transmission and if the channel has been sensed to be idle during all the slot durations of a defer duration T_d immediately before the transmission. If the channel has not been sensed to be idle in a sensing slot duration T_{sl} when the wireless device first senses the channel after it is ready to transmit, or if the channel has not been sensed to be idle during any of the sensing slot durations of a defer duration T_d immediately before the intended transmission, the wireless device may proceed to action 1 after sensing the channel to be idle during the slot durations of a defer duration T_d.

[0179] The defer duration T_d may consist of duration $T_f = 16us$ immediately followed by $m_p$consecutive slot durations where each slot duration is $T_{sl} = 9us$, and T_f includes an idle slot duration T_{sl} at start of T_f. $CW_{min,p} \leq CW_p \leq CW_{max,p}$ may be the contention window. $CW_{min,p}$ and $CW_{max,p}$ may be chosen before step 1 of the procedure above. m_p, $CW_{min,p}$, and $CW_{max,p}$ may be based on a channel access priority class p as shown in FIG. 16, that is signalled to the wireless device.

[0180] In an example, if a wireless device is indicated to perform Type 2A UL channel access procedures, the wireless device may use Type 2A UL channel access procedure for a UL transmission. The UE may transmit the transmission immediately after sensing the channel to be idle for at least a sensing interval $T_{\text{short_ul}} = 25us$. $T_{\text{short_ul}}$ may consist of a duration $T_f = 16us$ immediately followed by one slot duration $T_{sl} = 9us$ and T_f may include an idle slot duration T_{sl} at start of T_f. The channel may be considered to be idle for $T_{\text{short_ul}}$ if it is sensed to be idle during the slot durations of $T_{\text{short_ul}}$.

[0181] In an example, if a wireless device is indicated to perform Type 2B UL channel access procedures, the wireless device may use Type 2B UL channel access procedure for a uplink

transmission. The wireless device may transmit the transmission immediately after sensing the channel to be idle.

[0182] In an example, if a wireless device is indicated to perform Type 2C UL channel access procedures, the wireless device transmits immediately without sensing the channel.

[0183] In an example embodiment, a wireless device (e.g., a MAC entity of the wireless device) may employ one or more processes to handle the uplink LBT failures for uplink transmissions, such as uplink transmissions for one or more uplink channels (e.g., PUSCH, PUCCH and/or PRACH) and/or one or more signals (e.g., SRS). In an example, the wireless device may detect/determine consistent uplink LBT failures to detect/determine uplink LBT problems. A MAC entity of the wireless device may receive notifications of uplink LBT failures from the physical layer to detect consistent uplink LBT failures.

[0184] In an example, detection/determination of consistent uplink LBT failures may be based on a counter and/or timer. A value of the counter may be incremented based on detecting an uplink LBT failure. In an example, a threshold may be configured and a consistent uplink LBT failure may be determined based on the counter reaching the threshold. A consistent uplink LBT failure event may be triggered based on the uplink LBT failure counter reaching the threshold value. In an example, a timer may be started based on detecting a consistent uplink LBT failure and the value of the counter may be reset (e.g., reset to zero) based on an expiry of the timer. The wireless device may receive configuration parameters indicating the threshold value for the counter (e.g., a Max Count value) and a value of the timer. In an example, the threshold for the counter and/or the timer value may be configured per BWP and/or per cell. In an example, the threshold may be reset (e.g., reset to zero) based on the reconfiguration (e.g., in response to receiving an RRC reconfiguration message) of one or more parameters of the consistent uplink failure detection such as the threshold and/or timer value.

[0185] The wireless device may determine consistent LBT failure (e.g., for a cell and/or a BWP of the cell and/or an LBT sub-band of the BWP of the cell). The wireless device may indicate the consistent LBT failure (e.g., for a cell and/or a BWP of the cell and/or an LBT sub-band of the BWP of the cell) to the base station. The cell for which the wireless device may indicate consistent LBT failure may be a secondary cell or a primary cell (e.g., PCell or PSCell). In an example, the wireless device may autonomously take a recovery action. In an example, the wireless device may receive a command from the base station in response to indication of the consistent LBT failure to

the base station. The recovery action may include switching the BWP and/or performing a random access process (e.g., in the new BWP after switching). In an example, the wireless device may stop one or more timers (e.g., BWP inactivity timer) based on the detecting/determining the consistent LBT failure.

[0186] In an example, the determining/detecting of the consistent uplink LBT failure on a cell/BWP may be based on a plurality of uplink transmissions (e.g., via one or more uplink channels and/or one or more uplink signals) on the cell/BWP. In an example, the determining/detecting of the consistent uplink LBT failure may be independent of uplink transmission type. The LBT failures for different uplink transmissions may be used to determine the consistent uplink LBT failure regardless of the uplink transmission types (e.g., PUSCH, PUCCH, etc.). The consistent uplink LBT failure mechanism may have the same recovery mechanism for all uplink LBT failures regardless of the uplink transmission type.

[0187] In an example, based on detecting/determining/declaring consistent uplink LBT failures on PCell or PSCell, the wireless device may switch a current active BWP (of PCell or PSCell) to a second BWP (of PCell or PSCell). The wireless device may initiate a random access process in the second BWP based on the second BWP being configured with random access resources. The wireless device may perform radio link failure (RLF) recovery based on the consistent uplink LBT failure being detected on the PCell and consistent uplink LBT failure being detected on N possible BWPs of the PCell. In an example, based on detecting/determining consistent uplink LBT failures on a PSCell and after detecting a consistent uplink LBT failure on N BWPs of the PSCell, the wireless device may indicate a failure to a master base station via a secondary cell group (SCG) failure information procedure. In an example, N may be the number of configured BWPs with configured random access resources. In an example, after detecting consistent uplink LBT failure on PCell or PSCell, the wireless device may determine which BWP to switch if N is larger than one. The value of N may be configurable (e.g., via RRC) or may be pre-determined/pre-configured.

[0188] In an example, based on detecting/determining consistent uplink LBT failures on a cell (e.g., a SCell or PCell), the wireless device may indicate the consistent LBT failure on the cell to the base station based on an LBT failure indication MAC CE. The MAC CE may report consistent uplink LBT failure on one or more Cells. The MAC CE format may support multiple entries to indicate the Cells which have already declared consistent uplink LBT failures. In an example, the LBT failure indication MAC CE may indicate/include cell index(s) where uplink LBT failure

occurs. In an example, the format of the LBT failure indication MAC CE may be a bitmap to indicate whether corresponding serving cell has declared consistent uplink LBT failure or not.

[0189] The LBT failure indication MAC CE may be transmitted on a different serving cell than a SCell which has consistent UL LBT problem. In an example, the LBT failure indication MAC CE may indicate consistent uplink LBT failures on one or more cells and the wireless device may transmit the LBT failure indication MAC CE based on an uplink grant on a cell other than the one or more cells. The MAC CE for uplink LBT failure indication may have higher priority than data but lower priority than a beam failure recovery (BFR) MAC CE.

[0190] The wireless device may trigger scheduling request if there is no available uplink resource for transmitting the MAC CE for a SCell uplink LBT failure indication. The wireless device may receive configuration parameters of a SR configuration associated with uplink LBT failure indication. The configuration parameters may comprise an identifier indicating that the SR is associated with uplink LBT failure indication. In an example, when a SR configuration associated with uplink LBT failure indication is not configured for the wireless device and no resource is available for transmitting the MAC CE for indicating SCell uplink LBT failure, the wireless device may start a random access process.

[0191] In an example, when a SR for uplink LBT failure indication is triggered and the wireless device has an overlapping SR PUCCH resource with the SCell LBT failure SR PUCCH resource, the wireless device may select the SCell LBT failure SR PUCCH resource for transmission.

[0192] In an example, the wireless device may cancel the consistent LTB failure for a serving cell (or BWP(s)) (e.g., may not consider the cell as having consistent LBT failure) based on the wireless device successfully transmitting an LBT failure MAC CE indicating the serving cell.

[0193] In an example, when consistent UL LBT failure is declared on SpCell, the wireless device may trigger MAC CE to indicate where failure happened. The MAC CE may be sent on the BWP that the wireless device switched to during the random access process.

[0194] In an example, different LBT failures, irrespective of channel, channel access priority class, and LBT type, may be considered equivalent for the consistent UL LBT failure detection procedure at a MAC entity of a wireless device.

[0195] In an example, upon switching to a new BWP after detecting consistent LBT failures on a BWP of the PCell/PSCell, the wireless device may increment a counter (e.g., a BWP switching counter). The BWP switching counter may be used by the wireless device to initiate a radio link

failure process based on the BWP switching counter reaching a value (e.g., N). The wireless device may reset the BWP switching counter when the random access process on a BWP of the PCell/PSCell being successfully completed.

[0196] In an example, in response to the BWP switching due to consistent uplink LBT failure on PCell/PSCell, the wireless device may indicate the consistent uplink LBT failure via dedicated uplink resource (e.g. PRACH). For example, the PRACH resources used for indication of consistent uplink LBT failure may be dedicated to consistent uplink LBT failure indication

[0197] In an example, the uplink LBT failure information reported by the UE may include one or more BWP indexes of BWPs with consistent uplink LBT failures, one or more cell indexes of one or more cells with consistent uplink LBT failures and/or one or more measurement results (e.g., RSRP/RSRQ/RSSI/CO) of the serving/neighbor cells

[0198] In an example, the wireless device may perform an LBT for an uplink transmission comprising the uplink failure indication MAC CE based on a highest priority channel access priority class (e.g., lowest number channel access priority).

[0199] In an example, the wireless device may reset the uplink LBT counter for a cell/BWP based on expiry of an uplink LBT timer and/or based on receiving one or more messages indicating reconfiguration of uplink LBT configuration parameters for detecting consistent LBT failures and/or based on transmitting an uplink channel or uplink signal on the cell/BWP in response to successful uplink LBT. In an example, successful uplink LBT for the cell/BWP may indicate that the cell/BWP no longer has consistent LBT failures.

[0200] In an example, in response to BWP switching caused by detection of consistent uplink LBT failures on SpCell, a MAC entity may stop an ongoing random access procedure and may initiate a new random access procedure.

[0201] In an example, based on switching BWP due to detecting/declaring consistent LBT failure on a BWP of PCell or PSCell, the wireless device may initiate a random access process and may not perform other transmissions (e.g., may not resume suspended configured grants transmissions).

[0202] In an example, a wireless device may autonomously deactivate a configured grant for Sell(s) experiencing a consistent UL LBT failure.

[0203] In an example, based on detecting/declaring consistent uplink LBT failure for a cell/BWP, ongoing transmissions (e.g., PUSCH transmission, SRS transmission, PUCCH transmission,

RACH transmission, etc.) on active BWP of a SCell with consistent uplink LBT failure may be suspended.

[0204] In an example, based on detecting/declaring consistent uplink LBT failure for a cell/BWP, type 2 configured grants on the cell/BWP may be cleared. In an example, based on detecting/declaring consistent uplink LBT failure for a cell/BWP, type 1 configured grants on the cell/BWP may be suspended. In an example, based on detecting/declaring consistent uplink LBT failure for a BWP, BWP inactivity for a downlink BWP associated with the BWP may be stopped.

[0205] In an example, based on switching BWP due to detecting/declaring consistent LBT failure on a BWP of PCell or PSCell, a counter for detection of consistent uplink LBT failure of the BWP may be reset and/or a timer for consistent uplink LBT failure detection of the BWP may be stopped.

[0206] In an example, based on an uplink transmission failure due to LBT, a physical layer of a wireless device may send LBT failure indication to a MAC entity of the wireless device. The MAC entity of the wireless device may, based on receiving an LBT failure indication, start an lbt-FailureDetectionTimer and increment an LBT_COUNTER. Based on the lbt-FailureDetectionTimer expiring, the LBT_COUNTER may be reset. Based on LBT_COUNTER reaching a configured threshold value before the lbt-FailureDetectionTimer expiring, the wireless device may trigger a consistent uplink LBT failure event. In an example, a “failureType” in SCG failure information may indicate consistent uplink LBT failures.

[0207] In an example, the Scheduling Request (SR) may be used for requesting UL-SCH resources for new transmission. A MAC entity of a wireless device may be configured with zero, one, or more SR configurations. An SR configuration may comprise of a set of PUCCH resources for SR across different BWPs and cells. In an example, for a logical channel, a PUCCH resource for SR may be configured per BWP.

[0208] In an example, a SR configuration may correspond to one or more logical channels. A logical channel may be mapped to zero or one SR configuration, which may be configured by RRC. The SR configuration of the logical channel that triggered the buffer status report (BSR) (if such a configuration exists) may be considered as corresponding SR configuration for the triggered SR.

[0209] In an example, RRC may configure the following parameters for the scheduling request procedure: sr-ProhibitTimer (e.g., per SR configuration); and sr-TransMax (e.g., per SR

configuration). In an example, the following variables may be used for the scheduling request procedure: SR_COUNTER (e.g., per SR configuration).

[0210] In an example, if an SR is triggered and there are no other SRs pending corresponding to the same SR configuration, the MAC entity may set the SR_COUNTER of the corresponding SR configuration to 0.

[0211] In an example, when an SR is triggered, it may be considered as pending until it is cancelled. One or more pending SR(s) triggered prior to the MAC PDU assembly may be cancelled and respective sr-ProhibitTimer may be stopped when the MAC PDU is transmitted and this PDU includes a Long or Short BSR MAC CE which contains buffer status up to (and including) the last event that triggered a BSR prior to the MAC PDU assembly. One or more pending SR(s) may be cancelled and respective sr-ProhibitTimer may be stopped when the UL grant(s) can accommodate all pending data available for transmission.

[0212] In an example, PUCCH resources on a BWP which is active at the time of SR transmission occasion may be considered valid.

[0213] In an example, as long as at least one SR is pending, for each pending SR, if the MAC entity has no valid PUCCH resource configured for the pending SR, the MAC entity may initiate a Random Access procedure on the SpCell and cancel the pending SR.

[0214] In an example, based on at least one SR is pending, for each pending SR, if the MAC entity has valid PUCCH resource configured for the pending SR, for the SR configuration corresponding to the pending SR: when the MAC entity has an SR transmission occasion on the valid PUCCH resource for SR configured; and if sr-ProhibitTimer is not running at the time of the SR transmission occasion; and if the PUCCH resource for the SR transmission occasion does not overlap with a measurement gap; and if the PUCCH resource for the SR transmission occasion does not overlap with a UL-SCH resource: if SR_COUNTER < sr-TransMax: the wireless device may increment SR_COUNTER by 1; instruct the physical layer to signal the SR on one valid PUCCH resource for SR; and start the sr-ProhibitTimer. If SR_COUNTER = sr-TransMax: the wireless device may notify RRC to release PUCCH for all Serving Cells; notify RRC to release SRS for all Serving Cells; clear any configured downlink assignments and uplink grants; clear any PUSCH resources for semi-persistent CSI reporting; initiate a Random Access procedure on the SpCell and cancel all pending SRs.

[0215] In an example, the selection of which valid PUCCH resource for SR to signal SR on when the MAC entity has more than one overlapping valid PUCCH resource for the SR transmission occasion may be based on the wireless device implementation.

[0216] In an example, if more than one individual SR triggers an instruction from a MAC entity to a PHY layer to signal the SR on the same valid PUCCH resource, the SR_COUNTER for the relevant SR configuration may be incremented only once.

[0217] In an example, the MAC entity may stop, if any, ongoing Random Access procedure due to a pending SR which has no valid PUCCH resources configured, which was initiated by MAC entity prior to the MAC PDU assembly. Such a Random Access procedure may be stopped when the MAC PDU is transmitted using a UL grant other than a UL grant provided by Random Access Response, and this PDU includes a BSR MAC CE which contains buffer status up to (and including) the last event that triggered a BSR prior to the MAC PDU assembly, or when the UL grant(s) can accommodate all pending data available for transmission.

[0218] In an example, a wireless device may be configured by a higher layer paremater (e.g., SchedulingRequestResourceConfig) a set of configurations for SR in a PUCCH transmission for example using PUCCH format 0 or PUCCH format 1.

[0219] The wireless device may be configured a PUCCH resource by SchedulingRequestResourceId providing a PUCCH format 0 resource or a PUCCH format 1 resource. The wireless device may also be configured a periodicity $SR_{\text{PERIODICITY}}$ in symbols or slots and an offset SR_{OFFSET} in slots by periodicityAndOffset for a PUCCH transmission conveying SR. If $SR_{\text{PERIODICITY}}$ is larger than one slot, the UE may determine a SR transmission occasion in a PUCCH to be in a slot with number $n_{s,f}^{\mu}$ in a frame with number n_f if $\left(n_f \cdot N_{\text{slot}}^{\text{frame},\mu} + n_{s,f}^{\mu} - SR_{\text{OFFSET}}\right) mod\ S\ R_{\text{PERIODICITY}} = 0$.

[0220] In an example, if $SR_{\text{PERIODICITY}}$ is one slot, the UE may expect that $SR_{\text{OFFSET}} = 0$ and every slot may be a SR transmission occasion in a PUCCH.

[0221] In an example, if $SR_{\text{PERIODICITY}}$ is smaller than one slot, the UE may determine a SR transmission occasion in a PUCCH to start in a symbol with index l if $(l - l_0\ mod\ S\ R_{\text{PERIODICITY}})\ mod\ S\ R_{\text{PERIODICITY}} = 0$ where l_0 may be the value of startingSymbolIndex.

[0222] In an example, if the UE determines that, for a SR transmission occasion in a PUCCH, the number of symbols available for the PUCCH transmission in a slot is smaller than the value provided by nrofSymbols, the UE may not transmit the PUCCH in the slot.

[0223] In an example, the IE SchedulingRequestConfig may be used to configure the parameters, for the dedicated scheduling request (SR) resources.

[0224] In an example, the parameter schedulingRequestToAddModList may indicate a list of Scheduling Request configurations to add or modify. The parameter schedulingRequestToReleaseList may indicate a list of Scheduling Request configurations to release. The parameter schedulingRequestId may be used to modify a SR configuration and to indicate, in LogicalChannelConfig, the SR configuration to which a logical channel is mapped and to indicate, in SchedulingRequestresourceConfig, the SR configuration for which a scheduling request resource is used. The parameter sr-ProhibitTimer may indicate a timer for SR transmission on PUCCH. Value is in ms. Value ms1 may correspond to 1ms, value ms2 may correspond to 2ms, and so on. When the field is absent, the UE may apply the value 0. The parameter sr-TransMax may indicate maximum number of SR transmissions. Value n4 may correspond to 4, value n8 may correspond to 8, and so on.

[0225] In an example, the IE SchedulingRequestId may be used to identify a Scheduling Request instance in the MAC layer.

[0226] In an example, the IE SchedulingRequestResourceConfig may determine physical layer resources on PUCCH where the UE may send the dedicated scheduling request (D-SR). A parameter periodicityAndOffset may indicate SR periodicity and offset in number of symbols or slots. A parameter resource may indicate an ID of the PUCCH resource in which the UE may send the scheduling request. The actual PUCCH-Resource may be configured in PUCCH-Config of the same UL BWP and serving cell as this SchedulingRequestResourceConfig. The network may configure a PUCCH-Resource of PUCCH-format0 or PUCCH-format1 (other formats not supported). The schedulingRequestID may indicate an ID of the SchedulingRequestConfig that uses this scheduling request resource.

[0227] In an example, the IE SchedulingRequestResourceId may be used to identify scheduling request resources on PUCCH.

[0228] In an example as shown in FIG. 17, a wireless device may determine consistent LBT failures on a cell and/or a BWP of a cell and/or an LBT subband of a BWP of a cell. The

determination of consistent LBT failures on the cell/BWP/LBT subband may be based on counting a number of uplink LBT failures for uplink transmissions on the cell/BWP/LBT subband. The uplink transmission may be via an uplink channel (e.g., PUSCH, PUCCH, PRACH) or an uplink signal (e.g., SRS). For example, the wireless device may increment a counter based on determining/detecting an uplink LBT failure for an uplink transmission and may declare/trigger a consistent LBT failure indication based on the counter reaching a first value. The first value for the counter may be configurable (e.g., by RRC). The wireless device may receive configuration parameters comprising a first parameter indicating the first value. For example, a MAC entity of the wireless device may determine an LBT failure based on an indication of the LBT failure for the uplink transmission from the physical layer of the wireless device. The wireless device may start a timer based on receiving an LBT failure indication and may reset the LBT counter (e.g., reset to zero) based on the timer expiring. The wireless device may transmit an LBT failures indication MAC CE based on the triggering/declaring/determining a consistent LBT failure for a first cell/BWP/LBT subband. The LBT failures indication MAC CE may indicate consistent LBT failure on the first cell (and/or first BWP or first LBT subband of the first cell) and one or more other cells/BWPs/LB subbands that have consistent LBT failures.

[0229] In an example as shown in FIG. 18, the wireless device may declare/trigger consistent LBT failures on a cell/BWP/LBT subband based on a consistent LBT failure determination described earlier. The wireless device may determine that no uplink resource is available for transmission of an LBT failure indication MAC CE. Based on no uplink resource being available for transmission of the LBT failure indication MAC CE, the wireless device may trigger a scheduling request. The wireless device may transmit a scheduling request signal based on a scheduling request configuration. The scheduling request configuration may be for transmission of scheduling request signals related to uplink LBT failure recovery. In an example, as shown in FIG. 19, the wireless device may transmit multiple scheduling request signals based on not receiving an uplink grant for transmission of the consistent LBT failure MAC CE. Based on a SR counter reaching a maximum SR count, the wireless device may initiate a random access process.

[0230] In an example, as shown in FIG. 20, the wireless device may declare/trigger consistent LBT failures on a cell/BWP/LBT subband based on a consistent LBT failure determination described earlier. The wireless device may determine that no uplink resource is available for transmission of an LBT failure indication MAC CE. The wireless device may not be configured with a scheduling

request configuration and/or scheduling request resources for consistent LBT failures recovery. Based on no uplink resource being available for transmission of the LBT failure indication MAC CE and no scheduling request configuration and/or scheduling request resources for consistent LBT failures recovery, the wireless device may start a random access process.

[0231] In an example, the configuration parameters of the scheduling request configuration (e.g., a scheduling request identifier and/or other parameters) may indicate that the scheduling request configuration is for consistent LBT failure recovery. The scheduling request configuration may indicate resources comprising a first resource for transmission of the scheduling request signal.

[0232] In an example, a MAC entity of a wireless device may be configured by RRC with a beam failure recovery (BFR) procedure and with parameters for a beam failure recovery procedure. The beam failure recovery procedure may be used for indicating to a serving base station of a new SSB or CSI-RS based on beam failure being detected on the serving SSB(s)/CSI-RS(s). Beam failure may be detected by counting beam failure instance indications from the lower layers to the MAC entity.

[0233] In an example, if IE beamFailureRecoveryConfig is reconfigured by upper layers during an ongoing Random Access procedure for beam failure recovery, the MAC entity may stop the ongoing Random Access procedure and may initiate a Random Access procedure using the new configuration.

[0234] In an example, the following RRC configuration parameters may be received in one or more IEs such as BeamFailureRecoveryConfig and the RadioLinkMonitoringConfig for the Beam Failure Detection and Recovery procedure: beamFailureInstanceMaxCount for the beam failure detection; beamFailureDetectionTimer for the beam failure detection; beamFailureRecoveryTimer for the beam failure recovery procedure; rsrp-ThresholdSSB: an RSRP threshold for the beam failure recovery; powerRampingStep: powerRampingStep for the beam failure recovery; powerRampingStepHighPriority: powerRampingStepHighPriority for the beam failure recovery; preambleReceivedTargetPower: preambleReceivedTargetPower for the beam failure recovery; preambleTransMax: preambleTransMax for the beam failure recovery; scalingFactorBI: scalingFactorBI for the beam failure recovery; ssb-perRACH-Occasion: ssb-perRACH-Occasion for the beam failure recovery; ra-ResponseWindow: the time window to monitor response(s) for the beam failure recovery using contention-free Random Access Preamble; prach-ConfigurationIndex: prach-ConfigurationIndex for the beam failure recovery; ra-ssb-OccasionMaskIndex: ra-ssb-

OccasionMaskIndex for the beam failure recovery; ra-OccasionList: ra-OccasionList for the beam failure recovery. In an example, the UE variable BFI_COUNTER may indicate a counter for beam failure instance indication which may be initially set to 0.

[0235] In an example, beam failure instance indication may be received from lower layers. The MAC entity may start or restart the beamFailureDetectionTimer based on the receiving the beam failure instance indication. The MAC entity may increment BFI_COUNTER by 1 based on the receiving the beam failure instance indication. The MAC entity may initiate a Random Access procedure on the SpCell if BFI_COUNTER >= beamFailureInstanceMaxCount.

[0236] In an example, if the beamFailureDetectionTimer expires, the MAC entity may set BFI_COUNTER to 0. In an example, if beamFailureDetectionTimer, beamFailureInstanceMaxCount, or the reference signals used for beam failure detection is reconfigured by upper layers, the MAC entity may set BFI_COUNTER to 0.

[0237] In an example, if the Random Access procedure for beam failure recovery is successfully completed: the MAC entity may set BFI_COUNTER to 0; the MAC entity may stop the beamFailureRecoveryTimer, if configured; and the MAC entity may consider the Beam Failure Recovery procedure successfully completed.

[0238] In an example, an IE BeamFailureRecoveryConfig may be used to configure a wireless device with RACH resources and candidate beams for beam failure recovery in case of beam failure detection. In an example, a beamFailureRecoveryTimer parameter may indicate a timer for beam failure recovery timer. In an example, upon expiration of the timer the wireless may not use CFRA for BFR. The value of beamFailureRecoveryTimer may be in ms. For example, value ms10 may correspond to 10 ms, value ms20 may correspond to 20 ms, and so on. In an example, candidateBeamRSList may indicate a list of reference signals (e.g., CSI-RS and/or SSB) identifying the candidate beams for recovery and the associated RA parameters. In an example, the network may configure these reference signals to be within the linked DL BWP (e.g., within the DL BWP with the same bwp-Id) of the UL BWP in which the BeamFailureRecoveryConfig may be provided. In an example, a msg1-SubcarrierSpacing parameter may indicate subcarrier spacing for contention free beam failure recovery. Example values may include 15 kHz or 30 kHz (e.g., FR1), and 60 kHz or 120 kHz (e.g., FR2).

[0239] In an example, a rsrp-ThresholdSSB parameter may indicate L1-RSRP threshold used for determining whether a candidate beam may be used by the wireless device to attempt contention

free random access to recover from beam failure. In an example, ra-prioritization may indicate parameters which may apply for prioritized random access procedure for BFR. In an example, a ra-ssb-OccasionMaskIndex parameter may indicate explicitly signalled PRACH Mask Index for RA Resource selection. The mask may be valid for SSB resources. In an example, a rach-ConfigBFR parameter may indicate configuration of contention free random access occasions for BFR. In an example, a recoverySearchSpaceId parameter may indicate search space to use for BFR RAR. The network may configure this search space to be within the linked DL BWP (e.g., within the DL BWP with the same bwp-Id) of the UL BWP in which the BeamFailureRecoveryConfig is provided. In an example, the CORESET associated with the recovery search space may not be associated with another search space. Network may configure the wireless device with a value for this field when contention free random access resources for BFR are configured.

[0240] In an example, the IE RadioLinkMonitoringConfig may be used to configure radio link monitoring for detection of beam- and/or cell radio link failure. In an example, a beamFailureDetectionTimer parameter may indicate a timer for beam failure detection. The value of timer may be in number of "$Q_{out,LR}$ reporting periods of Beam Failure Detection" Reference Signal. Value pbfd1 may correspond to 1 $Q_{out,LR}$ reporting period of Beam Failure Detection Reference Signal, value pbfd2 may correspond to 2 $Q_{out,LR}$ reporting periods of Beam Failure Detection Reference Signal and so on. In an example, a beamFailureInstanceMaxCount parameter may determine after how many beam failure events the wireless device may trigger beam failure recovery. Value n1 may correspond to 1 beam failure instance, value n2 may correspond to 2 beam failure instances and so on. In an example, a failureDetectionResourcesToAddModList parameter may indicate a list of reference signals for detecting beam failure and/or cell level radio link failure (RLF). In an example, the network may configure at most two detectionResources per BWP for the purpose beamFailure or both. If no RSs are provided for the purpose of beam failure detection, the wireless device may perform beam monitoring based on the activated TCI-State for PDCCH. If no RSs are provided in this list for the purpose of RLF detection, the wireless device may perform Cell-RLM based on the activated TCI-State of PDCCH. The network may ensure that the wireless device has a suitable set of reference signals for performing cell-RLM.

[0241] In an example, SCell beam failure detection may be per cell. In an example, DL BWPs of a SCell may be configured with independent SCell BFR configurations. In an example, a SR ID may be configured for BFR within a same cell group (e.g., a PUCCH group). In an example, a SCell

BFRQ MAC CE may trigger a SCell BFRQ SR if there is no valid uplink grant which can accommodate the SCell BFRQ MAC CE. In an example, the transmission of the SCell BFRQ MAC CE may cancel a pending BFRQ SR of the failed SCell(s). In an example, when based on the number of the BFRQ SR transmission reaching the sr-TransMax, the wireless device may trigger a RACH procedure.

[0242] In an example, beamFailureDetectionTimer and beamFailureInstanceMaxCount may be configured cell specifically per DL BWP configured. In an example, based on reconfiguration of beamFailureDetectionTimer, beamFailureInstanceMaxCount, or any of the reference signals used for beam failure detection by upper layers, BFI_COUNTER my be set to 0 for the given Serving Cell. In an example, when SCell BFR SR resource is not configured and SCell BFR MAC CE transmission triggers SCell BFR SR, Random Access procedure on SpCell may be triggered to request UL resources to transmit the SCell BFR MAC CE.

[0243] In an example, when SCell BFR SR is triggered and the wireless device has an overlapping SR PUCCH resource with the SCell BFR SR PUCCH resource, the wireless device may all select the SCell BFR SR PUCCH resource for transmission. In an example, a pending SR for SCell beam failure recovery triggered prior to the MAC PDU assembly may be cancelled when the MAC PDU is transmitted and this PDU includes a SCell BFR MAC CE. In an example, SCell BFR MAC CE may carry information of multiple failed SCells, e.g., a multiple entry format for SCell BFR MAC CE may be used.

[0244] In an example, for a SCell, the SCell BFR MAC CE may indicate the following information: information about the failed SCell index, indication if new candidate beam RS is detected or not, and new candidate beam RS index (if available). In an example, SCell BFR MAC CE may have higher priority than data from logical channels except UL-CCCH and /or LBT failure indication MAC CE.

[0245] In an example as shown in FIG. 21, the wireless device may declare/trigger BFR on SCell on a cell based on a beam failure detection process described earlier. The wireless device may determine that no uplink resource is available for transmission of an BFR MAC CE. Based on no uplink resource being available for transmission of the BFR MAC CE, the wireless device may trigger a scheduling request. The wireless device may transmit a scheduling request signal based on a scheduling request configuration. The scheduling request configuration may be for transmission of scheduling request signals related to BFR. In an example, as shown in FIG. 22, the wireless

device may transmit multiple scheduling request signals based on not receiving an uplink grant for transmission of the BFR MAC CE. Based on a SR counter reaching a maximum SR count, the wireless device may initiate a random access process.

[0246] In an example, as shown in FIG. 23, the wireless device may declare/trigger BFR on SCell based on a beam failure detection process described earlier. The wireless device may determine that no uplink resource is available for transmission of a BFR MAC CE. The wireless device may not be configured with a scheduling request configuration and/or scheduling request resources for BFR. Based on no uplink resource being available for transmission of the BFR MAC CE and no scheduling request configuration and/or scheduling request resources for consistent LBT failures recovery, the wireless device may start a random access process.

[0247] In an example, the configuration parameters of the scheduling request configuration (e.g., a scheduling request identifier and/or other parameters) may indicate that the scheduling request configuration is for BFR. The scheduling request configuration may indicate resources comprising a first resource for transmission of the scheduling request signal.

[0248] In an example, a serving Cell may be configured with one or multiple BWPs. The BWP switching for a Serving Cell may be used to activate an inactive BWP and deactivate an active BWP at a time. The BWP switching may be controlled by the PDCCH indicating a downlink assignment or an uplink grant, by the bwp-InactivityTimer, by RRC signalling, or by the MAC entity itself upon initiation of Random Access procedure.

[0249] In an example, upon RRC (re-)configuration of firstActiveDownlinkBWP-Id and/or firstActiveUplinkBWP-Id for SpCell or activation of an SCell, the DL BWP and/or UL BWP indicated by firstActiveDownlinkBWP-Id and/or firstActiveUplinkBWP-Id respectively may be active without receiving PDCCH indicating a downlink assignment or an uplink grant. The active BWP for a Serving Cell may be indicated by RRC or PDCCH. For unpaired spectrum, a DL BWP may be paired with a UL BWP, and BWP switching may be common for both UL and DL.

[0250] In an example, for an activated Serving Cell configured with a BWP, if a BWP is activated, the MAC entity may transmit on UL-SCH on the BWP; transmit on RACH on the BWP, if PRACH occasions are configured; monitor the PDCCH on the BWP; transmit PUCCH on the BWP, if configured; report CSI for the BWP; transmit SRS on the BWP, if configured; receive DL-SCH on the BWP; (re-)initialize suspended configured uplink grants of configured grant Type 1 on the active BWP according to the stored configuration, if any, and to start in a symbol.

[0251] In an example, for an activated Serving Cell configured with a BWP, if a BWP is deactivated, the MAC entity may not transmit on UL-SCH on the BWP; the MAC entity may not monitor the PDCCH on the BWP; the MAC entity may not transmit PUCCH on the BWP; the MAC entity may not report CSI for the BWP; the MAC entity may not transmit SRS on the BWP; the MAC entity may not receive DL-SCH on the BWP; the MAC entity may clear configured downlink assignment and configured uplink grant of configured grant Type 2 on the BWP; the MAC entity may suspend configured uplink grant of configured grant Type 1 on the inactive BWP.

[0252] In an example, upon initiation of the Random Access procedure on a Serving Cell, the wireless device may select a carrier for performing Random Access procedure. The PRACH occasions may not be configured for the active UL BWP. The MAC entity may, for the selected carrier of this Serving Cell, switch the active UL BWP to BWP indicated by initialUplinkBWP. If the Serving Cell is an SpCell, the MAC entity may, for the selected carrier of this Serving Cell, switch the active DL BWP to BWP indicated by initialDownlinkBWP.

[0253] In an example, upon initiation of the Random Access procedure on a Serving Cell, the wireless device may select a carrier for performing Random Access procedure. The PRACH occasions may be configured for the active UL BWP. If the Serving Cell is an SpCell, if the active DL BWP does not have the same bwp-Id as the active UL BWP, the MAC entity may, for the selected carrier of this Serving Cell, switch the active DL BWP to the DL BWP with the same bwp-Id as the active UL BWP.

[0254] In an example, upon initiation of the Random Access procedure on a Serving Cell, the wireless device may select a carrier for performing Random Access procedure. The MAC entity may for the selected carrier of this Serving Cell, stop the bwp-InactivityTimer associated with the active DL BWP of this Serving Cell, if running. If the Serving Cell is SCell, the MAC entity may, for the selected carrier of this Serving Cell, stop the bwp-InactivityTimer associated with the active DL BWP of SpCell, if running. The MAC entity may, for the selected carrier of this Serving Cell, perform the Random Access procedure on the active DL BWP of SpCell and active UL BWP of this Serving Cell.

[0255] In an example, if the MAC entity receives a PDCCH for BWP switching of a Serving Cell, if there is no ongoing Random Access procedure associated with this Serving Cell; or if the ongoing Random Access procedure associated with this Serving Cell is successfully completed

upon reception of this PDCCH addressed to C-RNTI, the MAC entity may perform BWP switching to a BWP indicated by the PDCCH.

[0256] In an example, if the MAC entity receives a PDCCH for BWP switching for a Serving Cell while a Random Access procedure associated with that Serving Cell is ongoing in the MAC entity, it may be up to wireless device implementation whether to switch BWP or ignore the PDCCH for BWP switching, except for the PDCCH reception for BWP switching addressed to the C-RNTI for successful Random Access procedure completion in which case the wireless device may perform BWP switching to a BWP indicated by the PDCCH. Upon reception of the PDCCH for BWP switching other than successful contention resolution, if the MAC entity decides to perform BWP switching, the MAC entity may stop the ongoing Random Access procedure and initiate a Random Access procedure after performing the BWP switching; if the MAC decides to ignore the PDCCH for BWP switching, the MAC entity may continue with the ongoing Random Access procedure on the Serving Cell.

[0257] In an example, upon reception of RRC (re-)configuration for BWP switching for a Serving Cell while a Random Access procedure associated with that Serving Cell is ongoing in the MAC entity, the MAC entity may stop the ongoing Random Access procedure and initiate a Random Access procedure after performing the BWP switching.

[0258] In an example, the defaultDownlinkBWP-Id may be configured, and the active DL BWP may not be the BWP indicated by the defaultDownlinkBWP-Id. In an example the defaultDownlinkBWP-Id may not configured, and the active DL BWP may not bethe initialDownlinkBWP. A PDCCH addressed to C-RNTI or CS-RNTI indicating downlink assignment or uplink grant may be received on the active BWP; or a PDCCH addressed to C-RNTI or CS-RNTI indicating downlink assignment or uplink grant may be received for the active BWP; or a MAC PDU may be transmitted in a configured uplink grant or received in a configured downlink assignment. If there is no ongoing Random Access procedure associated with this Serving Cell; or if the ongoing Random Access procedure associated with this Serving Cell is successfully completed upon reception of this PDCCH addressed to C-RNTI: the MAC entity may start or restart the bwp-InactivityTimer associated with the active DL BWP.

[0259] In an example, the defaultDownlinkBWP-Id may be configured, and the active DL BWP may not be the BWP indicated by the defaultDownlinkBWP-Id. In an example the defaultDownlinkBWP-Id may not configured, and the active DL BWP may not bethe

initialDownlinkBWP. The bwp-InactivityTimer associated with the active DL BWP may expire. If the defaultDownlinkBWP-Id is configured, the MAC entity may perform BWP switching to a BWP indicated by the defaultDownlinkBWP-Id. Otherwise, the MAC entity may perform BWP switching to the initialDownlinkBWP.

[0260] In an example, if a Random Access procedure is initiated on an SCell, both this SCell and the SpCell may be associated with this Random Access procedure.

[0261] In an example, a PDCCH for BWP switching may be received, and the MAC entity may switch the active DL BWP. If the defaultDownlinkBWP-Id is configured, and the MAC entity switches to the DL BWP which is not indicated by the defaultDownlinkBWP-Id; or if the defaultDownlinkBWP-Id is not configured, and the MAC entity switches to the DL BWP which is not the initialDownlinkBWP, the MAC entity may start or restart the bwp-InactivityTimer associated with the active DL BWP.

[0262] A wireless device may be configured with a beam failure recovery procedure and may use a beam failure detection process to detect beam failures on the one or more serving SSBs and/or one or more serving CSI-RSs. Beam failure may be detected/determined based on a beam failure detection process comprising counting beam failure instance indications/notifications from the physical layer to a MAC entity. The wireless device may start a beam failure recovery procedure based on the detecting/determining the beam failure on a cell. The beam failure recovery may be based on performing a random access process, for example on a primary cell. The wireless device may detect consistent LBT failures on one or more cells and may perform a random access process to recover from the consistent LBT failures on the one or more cells. When the one or more cells have consistent LBT failures and one or more second cells have beam failure, there may be a conflict between the consistent LBT failures recovery process and the beam failure recovery process. Existing solutions for beam failure and consistent LBT failure recovery processes may lead to degraded wireless device and network performance. There is a need to enhance the existing beam failure and consistent LBT failures recovery processes. Example embodiments enhance the beam failure and consistent LBT failures recovery processes.

[0263] In an example, a wireless device may receive one or more messages comprising configuration parameters. The one or more messages may comprise one or more RRC messages. The one or more messages may comprise configuration parameters of a plurality of cells. The plurality of cells may comprise a first plurality of unlicensed cells. The plurality of cells may

comprise a primary cell and one or more secondary cells. The plurality of cells may comprise a plurality of cell groups. A first cell group of the plurality of cell groups may be served by a first base station (e.g., a master bae station) and a second cell group of the plurality of cell groups may be served by a second base station (e.g., a secondary base station).

[0264] In an example the plurality of cells may comprise a plurality of PUCCH groups. A first PUCCH group (e.g., a primary PUCCH group) in the plurality of PUCCH groups may comprise a first plurality of cells, of the plurality of cells, comprising a primary cell, wherein the primary cell may carry first uplink control information (UCI) associated with the first plurality of cells. A second PUCCH group in the plurality of PUCCH groups may comprise a second plurality of cells, of the plurality of cells, comprising a PUCCH SCell, wherein the PUCCH SCell may carry second UCI associated with the second plurality of cells.

[0265] The one or more messages may comprise first configuration parameters for consistent LBT failure detection and recovery. The first configuration parameters may comprise one or more counter values for one or more counters (e.g., one or more LBT counters) and one or more timer values for one or more timers (e.g., one or more consistent uplink LBT failure detection timers). The wireless device may employ the one or more timers and the one or more counters for consistent LBT failures detection on one or more cells. The wireless device may employ the first configuration parameters for consistent LBT failure detection and recovery on one or more cells.

[0266] The one or more messages may comprise second configuration parameters for beam failure detection and beam failure recovery (BFR). The second configuration parameters may comprise one or more counter values for one or more counters/variables (e.g., beam failure instance counter/variable) and one or more timer values for one or more timers (e.g., beam failure detection timer). The wireless device may employ the one or more counters/variables and the one or more timers for beam failure detection and beam failure recovery.

[0267] In an example, the one or more messages may comprise first scheduling request configuration parameters for consistent LBT failure recovery. The first scheduling request configuration parameters may comprise a first identifier indicating that the first scheduling request configuration is for consistent LBT failure recovery. The first scheduling request configuration may indicate first PUCCH resources for transmission of scheduling requests for recovery from consistent LBT failures on one or more cells. The first scheduling request configuration may comprise first parameters (e.g., first periodicity and offset, first PUCCH resource identifiers, etc.)

indicating the first PUCCH resources for transmission of scheduling request signals for consistent LBT failures recovery. In an example, the one or more messages may comprise configuration parameters of a plurality of scheduling request configurations comprising the first scheduling request configuration for consistent LBT failures recovery. In an example, the first scheduling request configuration may indicate the scheduling resources for transmission via a PUCCH of a primary cell and/or via a PUCCH of a SCell configured with PUCCH. In an example, the scheduling requests for consistent LBT failures on a cell in a primary PUUCH group may be transmitted via scheduling request resources on a primary cell. In an example, the scheduling request signals for consistent LBT failures on a cell in a secondary PUCCH group may be transmitted via scheduling request resources on a PUCCH SCell.

[0268] In an example, the one or more messages may comprise second scheduling request configuration parameters for beam failure recovery. The second scheduling request configuration parameters may comprise a second identifier indicating that the second scheduling request configuration is for beam failure recovery. The second scheduling request configuration may indicate second PUCCH resources for transmission of scheduling requests for recovery from beam failure on one or more cells. The second scheduling request configuration may comprise second parameters (e.g., second periodicity and offset, second PUCCH resource identifiers, etc.) indicating the second PUCCH resources for transmission of scheduling request signals for BFR. In an example, the one or more messages may comprise configuration parameters of a plurality of scheduling request configurations comprising the second scheduling request configuration for beam failure recovery. In an example, the second scheduling request configuration may indicate the scheduling resources for transmission via a PUCCH of a primary cell and/or via a PUCCH of a SCell configured with PUCCH. In an example, the scheduling requests for beam failure on a cell in a primary PUUCH group may be transmitted via scheduling request resources on a primary cell. In an example, the scheduling request signals for beam failure on a cell in a secondary PUCCH group may be transmitted via scheduling request resources on a PUCCH SCell.

[0269] In an example, the one or more messages may comprise random access configuration parameters indicating radio resources and/or RACH occasions for transmission of random access preambles and/or random access messages. The random access configuration parameters may comprise cell-specific and dedicated parameters. In an example, the cell specific and dedicated random access parameters may comprise parameters related to regular random access and/or

random access for beam failure recovery. In an example, the cell-specific and/or dedicated random access configuration parameters may comprise first parameters of random access for consistent LBT failures recovery.

[0270] In example embodiments as shown in FIG. 24 - FIG. 26, a wireless device may determine consistent uplink LBT failures on one or more cells of a plurality of unlicensed cells configured for the wireless device. The wireless device may determine the consistent LBT failures on the one or more cells based on a consistent LBT failure detection process. The consistent LBT failures detection process may employ indications of LBT failures for uplink transmissions (e.g., one or more uplink channel transmissions, e.g., PUSCH, PUCCH and/or one or more uplink signal transmissions, e.g., SRS) from a physical layer of the wireless device and may employ one or more counters (e.g., LBT counter) and one or more timers (e.g., consistent LBT detection timer) for detection of the consistent LBT failures.

[0271] The wireless device may start a first random access process on a primary cell based on the determining the consistent LBT failures on the one or more cells. In an example, the one or more cells with consistent LBT failures may comprise a primary cell. The starting the first random access on the primary cell may be based on the one or more cells with consistent LBT failures comprising the primary cell. In an example, the one or more cells with consistent LBT failures may comprise the primary cell and one or more secondary cells. In an example, based on the one or more cells with consistent LBT failures comprising the primary cell, the wireless device may switch from a first BWP of the primary cell to a second BWP of the primary cell and may start the first random access process on the second BWP of the primary cell. The consistent LBT failure on the primary cell may be determined on the first BWP of the primary cell and the wireless device may switch from the first BWP of the primary cell to the second BWP of the primary cell and may start the first random access process based the consistent LBT failures on the first BWP of the primary cell.

[0272] In an example, the wireless device may trigger LBT failure indication based on the determining the consistent LBT failure on the one or more cells. The wireless device may have no uplink resources for transmission of an uplink LBT failure indication MAC CE. The wireless device may not be configured with a scheduling request configuration/resources for consistent LBT failure recovery. The starting the first random access on the primary cell may be based on the triggering the LBT failure indication, no uplink resources being available for transmission of an

LBT failures indication MAC CE and no scheduling request resource/configuration for consistent LBT failures being configured for the wireless device.

[0273] In an example, the wireless device may trigger LBT failure indication based on the determining the consistent LBT failures on the one or more cells. The wireless device may have no uplink resources for transmission of an LBT failure indication MAC CE. The wireless device may be configured with a scheduling request configuration for consistent LBT failures recovery. The wireless device may trigger scheduling request based on no uplink resources being available for transmission of the LBT failure indication MAC CE. The wireless device may transmit scheduling request signals (e.g., based on the scheduling request configuration for consistent LBT failures recovery) and, in response to the transmitted scheduling request signals, may not receive an uplink grant useful for transmission of the LBT failure indication MAC CE. The starting the first random access process may be based on transmitting scheduling request signals (e.g., for a maximum count of scheduling request transmissions) for consistent LBT failures recovery and not receiving an uplink grant for transmission of a the LBT failure indication MAC CE. The wireless device may receive a configuration parameter that indicates the maximum count of SR transmissions before starting a first random access process.

[0274] In an example, the first random access process on the primary cell may be a four-step random access process. The wireless device may transmit a random access preamble based on the starting the first random access process. In an example, the first random access process may be a two-step random access process. The wireless device may transmit a Msg A (e.g., a random access preamble and a packet) based on the starting the first random access and the first random access process being a two-step random access process.

[0275] In example embodiments as shown in FIG. 24 - FIG. 26, the wireless device may detect beam failure on a first cell. The wireless device may detect beam failure on the first cell based on one or more serving SSBs and/or one or more serving CSI-RSs. In an example, the detecting the beam failure on the first cell may be based on indications/notifications of beam failure instances from physical layer of the wireless device to a MAC entity of the wireless device. The wireless device may detect the beam failure on the first cell based on a beam failure detection process employing one or more counters and/or wireless device variables (e.g., a BFI_COUNTER incremented based on receiving beam failure instance indications/notifications from physical layer) and one or more timers (e.g., beam failure detection timer).

[0276] In an example embodiment as shown in FIG. 24, based on the detecting/determining the beam failure on the first cell, the wireless device may stop the first random access process (e.g., for consistent LBT failures recovery) on the primary cell and may start a second process on the primary cell for beam failure recovery. The wireless device may start the second random access for beam failure recovery after stopping the first random access. In an example, the stopping the first random access process may comprise stopping transmission of a random access preamble (or Msg A in case of two-step random access) and/or stopping monitoring control channel for random access response. In an example, the starting the second random access process may comprise transmitting a random access preamble (e.g., for four-step random access process) or transmitting a Msg A (e.g., for two-step random access process) on the primary cell.

[0277] In an example, the wireless device may further start a third random access process on the primary cell for consistent LBT failures recovery based on the second random access for beam failure recovery being successfully completed. The wireless device may start the third random access process by transmitting a random access preamble or Msg A (e.g., in case of two-step random access) using a RACH occasion on the primary cell that occurs after the completion of second random access process. The wireless device may transmit the random access preamble or Msg A using a RACH occasion after receiving a random access response or Msg 4/Msg B associated with the second random access process indicating successful completion of the second random access process. In an example, the third random access process may be a two-step random access process and the wireless device may transmit a Msg A based on starting the third random access process. In an example, the third random access process may be a four-step random access process and the wireless device may transmit a random access preamble based on starting the third random access process.

[0278] In an example embodiment as shown in FIG. 25, based on the detecting/determining the beam failure on the first cell, the wireless device may continue the first random access process (e.g., for consistent LBT failures recovery) on the primary cell. The wireless device may start a second random access process on the primary cell for beam failure recovery based on the first random access for consistent LBT failure being successfully completed. In an example, the starting the second random access process may comprise transmitting a random access preamble or transmitting a Msg A (e.g., for two-step random access process) on the primary cell. The starting the second random access process may comprise transmitting a random access preamble or Msg A

via a RACH resource on the primary cell after receiving a random access response or a Msg 4/Msg B associated with the first random access process indicating successful completion of the first random access process.

[0279] In an example embodiment as shown in FIG. 26, based on the detecting/determining the beam failure on the first cell, the wireless device may continue or stop the first random access process (for consistent LBT failures recovery) on the primary cell based on a stage of the first random access process, for example depending on whether a RAR/ Msg 4/ Msg B has been received from the base station or depending on whether a Msg 1/ Msg A/ Msg 3 has been transmitted, etc. For example, the wireless device may continue the first random access process (for consistent LBT failures recovery) if the wireless device has received a random access response or a Msg 4 or a Msg B and determines/detects the beam failure on the first cell after receiving the random access response or Msg 4 or Msg B. For example, the wireless device may stop the first random access process (for consistent LBT failures recovery) if the wireless device has not received a random access response or a Msg 4 or a Msg B and determines/detects the beam failure on the first cell before receiving the random access response or Msg 4 or Msg B.

[0280] In an example, the first cell wherein the beam failure is determined may be a primary cell. The wireless device may start the second random access process for beam failure recovery based on the first cell being the primary cell. In an example, a beam failure recovery process may comprise starting a random access process based on a cell on which the beam failure is detected being a primary cell.

[0281] In an example, the first cell wherein the beam failure is determined may be a secondary cell. The wireless device may trigger a beam failure recovery MAC CE. In an example, the wireless device may trigger the beam failure recovery MAC CE based on the first cell being a secondary cell. The wireless device may have no uplink resources for transmission of the beam failure recovery MAC CE. The starting the second random access process on the primary cell for beam failure recovery may be based on the triggering the beam failure recovery and based on no scheduling request resource/configuration for beam failure recovery being configured for the wireless device.

[0282] In an example, the first cell wherein the beam failure is determined may be a secondary cell. The wireless device may trigger a beam failure recovery MAC CE. In an example, the wireless device may trigger the beam failure recovery MAC CE based on the first cell being a secondary

cell. The wireless device may have no uplink resources for transmission of the beam failure recovery MAC CE. The wireless device may be configured with a scheduling request configuration for beam failure recovery, wherein the scheduling request configuration may indicate scheduling request resources for beam failure recovery. The wireless device may transmit a plurality of scheduling request signals for beam failure recovery based on the scheduling request configuration for beam failure recovery. The plurality of scheduling request signals may be transmitted via scheduling request resources determined based on one or more scheduling request configuration parameters for beam failure recovery. A number of the plurality of scheduling request signals may be a first number (e.g., a maximum scheduling request count before starting a random access process). The wireless device may not receive an uplink grant for transmission of a beam failure recovery MAC CE based on the transmitting the plurality of scheduling request signals. The starting the second random access process for beam failure recovery on the primary cell may be based the transmitting the plurality of scheduling request signals and not receiving an uplink grant for transmission of the beam failure recovery MAC CE.

[0283] In an example embodiment as shown in FIG. 27-FIG. 33, a wireless device may determine beam failure on a first cell. The wireless device may determine the beam failure on the first cell based on a beam failure detection process. A beam failure instance counter/variable may reach a first value (e.g., a beam failure instance count max value) based on receiving indications/notifications of beam failure instances from the physical layer. Based on the determining the beam failure on the first cell, the wireless device may start a first random access process for beam failure recovery. The wireless device may transmit a random access preamble or a Msg A (e.g., in case of a two-step random access process) based on the starting the first random access process on the primary cell.

[0284] In an example, the first cell wherein the beam failure is determined may be a primary cell. The wireless device may start the first random access process for beam failure recovery based on the first cell being the primary cell. In an example, a beam failure recovery process may comprise starting a random access process based on a cell on which the beam failure is detected being a primary cell.

[0285] In an example, the first cell wherein the beam failure is determined may be a secondary cell. The wireless device may trigger a beam failure recovery MAC CE. In an example, the wireless device may trigger the beam failure recovery MAC CE based on the first cell being a secondary

cell. The wireless device may have no uplink resources for transmission of the beam failure recovery MAC CE. The starting the first random access process on the primary cell for beam failure recovery may be based on the triggering the beam failure recovery and based on no scheduling request resource/configuration for beam failure recovery being configured for the wireless device.

[0286] In an example, the first cell wherein the beam failure is determined may be a secondary cell. The wireless device may trigger a beam failure recovery MAC CE. In an example, the wireless device may trigger the beam failure recovery MAC CE based on the first cell being a secondary cell. The wireless device may have no uplink resources for transmission of the beam failure recovery MAC CE. The wireless device may be configured with a scheduling request configuration for beam failure recovery, wherein the scheduling request configuration may indicate scheduling request resources for beam failure recovery. The wireless device may transmit a plurality of scheduling request signals for beam failure recovery based on the scheduling request configuration for beam failure recovery. The plurality of scheduling request signals may be transmitted via scheduling request resources determined based on one or more scheduling request configuration parameters for beam failure recovery. A number of the plurality of scheduling request signals may be a first number (e.g., a maximum scheduling request count before starting a random access process). The wireless device may not receive an uplink grant for transmission of a beam failure recovery MAC CE based on the transmitting the plurality of scheduling request signals. The starting the first random access process for beam failure recovery on the primary cell may be based the transmitting the plurality of scheduling request signals and not receiving an uplink grant for transmission of the beam failure recovery MAC CE.

[0287] In an example, the wireless device may determine consistent LBT failure on one or more cells of a plurality of unlicensed cells configured for the wireless device, wherein the one or more cells comprise a primary cell. The wireless device may determine the consistent LBT failures on the one or more cells based on a consistent LBT failure detection process. The consistent LBT failures detection process may employ indications of LBT failures for uplink transmissions (e.g., one or more uplink channel transmissions, e.g., PUSCH, PUCCH and/or one or more uplink signal transmissions, e.g., SRS) from a physical layer of the wireless device and may employ one or more counters (e.g., LBT counter) and one or more timers (e.g., consistent LBT detection timer) for detection of the consistent LBT failures.

[0288] In an example embodiment as shown in FIG. 27, FIG. 29, based on the determining the consistent LBT failures on the one or more cells comprising the primary cell, the wireless device may stop the first random access process. The stopping the first random access process may comprise stopping transmission of a random access preamble (or Msg A in case of two-step random access) and/or stopping monitoring control channel for random access response. Based on the determining the consistent LBT failures on the one or more cells comprising the primary cell, the wireless device may switch from a first bandwidth part of the primary cell to a second bandwidth part of the primary cell. The wireless device may switch from the first BWP of the primary cell to the second BWP of the primary cell based on the one or more cells with consistent LBT failures comprising the primary cell.

[0289] In an example embodiment as shown on FIG. 27, the wireless device may start a second random access process for beam failure recovery based on the switching from the first BWP of the primary cell to the second bandwidth part of the primary cell. The wireless device may start the second random access process on the second BWP of the primary cell after switching from the first BWP of the primary cell to the second BWP of the primary cell. The starting the second random access may comprise transmitting a random access preamble or transmitting a Msg A (e.g., in case of a two-step random access) via a RACH occasion of the primary cell (e.g., on the second BWP of the primary cell).

[0290] In an example, the wireless device may start a third random access process on the primary cell for consistent LBT failure recovery based on the second random access for beam failure recovery being successfully completed. The wireless device may start the third random access process on the second BWP of the primary cell (e.g., after switching from the first BWP to the second BWP and after successful completion of the second random access process). The wireless device may start the third random access process on the primary cell based on the one or more cells with consistent LBT failures comprising the primary cell. The third random access process on the primary cell may be one of a two-step or four-step random access process. The starting the third random access process may comprise transmitting a random access preamble or a Msg A (e.g., in case of a two-step random access process) via a RACH occasion that occurs after receiving a random access response or a Msg4 indicating successful completion of the second random access process.

[0291] In an example embodiment as shown in FIG. 29, the wireless device may start a second random access process for consistent LBT failures recovery on the second bandwidth part of the primary cell. The starting the second random access process may comprise transmitting a random access preamble or a Msg A (e.g., in case of a two-step random access) via a RACH occasion configured for the second BWP of the primary cell. The second random access process may be successfully completed based on receiving a random access response or a Msg 4 indicating successful completion of the second random access process. The wireless device may start a third random access process for beam failure recovery based on the second random access for consistent LBT failures recovery being successfully completed. The wireless device may transmit a random access preamble or a Msg A (e.g., in case of two-step random access process) via a RACH occasion of the second bandwidth part of the second bandwidth after the successful completion of the second random access process. The third random access process may be one of a two-step random access process or four-step random access process.

[0292] In an example embodiment as shown in FIG. 31, based on determining the consistent LBT failures on the one or more cells comprising the primary cell, the wireless device may continue the first random access process for beam failure recovery. The first random access may be successfully completed. The successful completion of the first random access process may be based on receiving a random access response or a Msg 4 indicating successful completion of the first random access process. The wireless device may switch from the first bandwidth part of the primary cell to the second bandwidth part of the primary cell based on the determining the consistent LBT failures on the one or more cells comprising the primary cell and based on the successful completion of the first random access. The wireless device may switch from the first bandwidth part of the primary cell to the second bandwidth part of the primary cell after the successful completion of the first random access and based on a timing. The wireless device may start a second random access, for consistent LBT failures recovery, on the second BWP of the primary cell. The starting the second random access process may comprise transmitting a random access preamble or a Msg A (e.g., in case of a two-step random access process).

[0293] In an example, the wireless device may determine consistent LBT failure on one or more secondary cells of a plurality of unlicensed cells configured for the wireless device. The wireless device may determine the consistent LBT failures on the one or more secondary cells based on a consistent LBT failure detection process. The consistent LBT failures detection process may

employ indications of LBT failures for uplink transmissions (e.g., one or more uplink channel transmissions, e.g., PUSCH, PUCCH and/or one or more uplink signal transmissions, e.g., SRS) from a physical layer of the wireless device and may employ one or more counters (e.g., LBT counter) and one or more timers (e.g., consistent LBT detection timer) for detection of the consistent LBT failures.

[0294] In an example embodiment as shown in FIG. 28, based on the determining the consistent LBT failures on the one or more secondary cells, the wireless device may continue the first random access process for beam failure recovery. The first random access process for beam failure recovery may be successfully completed, for example, based on receiving a random access response or a based on receiving a Msg 4/Msg B indicating successful completion of the first random access process. The wireless device may start a second random access process for consistent LBT failures recovery based on the first random access process being successfully completed. The starting the second random access process may comprise transmitting a random access preamble or transmitting a Msg A (e.g., in case of a two-step random access).

[0295] In an example embodiment as shown in FIG. 30, based on the determining the consistent LBT failures on the one or more secondary cells, the wireless device may stop the first random access process for beam failure recovery. The stopping the first random access process may comprise stopping transmission of a random access preamble or Msg A (e.g., in case of two-step random access) and/or stopping monitoring a random access response. The wireless device may start a second random access process for consistent LBT failures recovery based on stopping the first random access process. The wireless device may start the second random access process after the stopping the first random access process. The starting the second random access process may comprise transmission of a random access preamble or a Msg A (e.g., for a two-step random access process). The second random access process may be successfully completed based on reception of a random access response or a Msg 4/Msg B indicating successful completion of the second random access process. The wireless device may start a third random access process for beam failure recovery based on the second random access process for consistent LBT failures being successfully completed.

[0296] In an example embodiment as show in FIG. 32, based on the determining the consistent LBT failures on the one or more secondary cells, the wireless device may continue the first random access process for beam failure recovery. The first random access may be successfully completed.

The successful completion of the first random access may be based on reception of a random access response or a Msg B/Msg 4 indicating successful completion of the first random access process. The wireless device may start a second random access process for consistent LBT failures recovery based on the successful completion of the first random access process. The wireless device may start the second random access process for consistent LBT failures recovery by transmission of a random access preamble or a Msg A (e.g. in case of a two-step random access process) via a RACH occasion of the primary cell after the successful completion of the first random access process, e.g., after reception of the RAR or Msg 4/Msg B associated with the first random access process indicating the successful completion of the first random access process.

[0297] In an example, the wireless device may trigger LBT failure indication based on the determining the consistent LBT failures on the one or more secondary cells. The wireless device may have no uplink resources for transmission of an LBT failure indication MAC CE. The wireless device may not be configured with a scheduling request configuration/resources for consistent LBT failure recovery. The starting the second random access process on the primary cell may be based on the triggering the LBT failure indication, no uplink resources being available for transmission of an LBT failures indication MAC CE and no scheduling request resource/configuration for consistent LBT failures being configured for the wireless device.

[0298] In an example, the wireless device may trigger LBT failure indication based on the determining the consistent LBT failures on the one or more secondary cells. The wireless device may have no uplink resources for transmission of an LBT failure indication MAC CE. The wireless device may be configured with a scheduling request configuration for consistent LBT failures recovery. The wireless device may trigger scheduling request based on no uplink resources being available for transmission of the LBT failure indication MAC CE. The wireless device may transmit scheduling request signals (e.g., based on the scheduling request configuration for consistent LBT failures recovery) and, in response to the transmitted scheduling request signals, may not receive an uplink grant useful for transmission of the LBT failure indication MAC CE. The starting the second random access process may be based on transmitting scheduling request signals (e.g., for a maximum count of scheduling request transmissions) for consistent LBT failures recovery and not receiving an uplink grant for transmission of a the LBT failure indication MAC CE. The wireless device may receive a configuration parameter that indicates the maximum count of SR transmissions before starting the second random access process.

[0299] In an example embodiment as shown in FIG. 33, based on the determining the consistent LBT failures on the one or more cells, the wireless device may continue or stop the first random access process (for beam failure recovery) on the primary cell based on a stage of the random access process, for example depending on whether a RAR has been received from the base station or depending on whether a Msg 1/ Msg A/ Msg 3 has been transmitted, etc. For example, the wireless device may continue the first random access process (for beam failure recovery) if the wireless device has transmitted the random access preamble or Msg A and determines the consistent LBT failures on the one or more cells after transmitting the random access preamble or Msg A. The wireless device may stop the first random access (for beam failure recovery) if the wireless device has not transmitted the random access preamble or Msg A and determines the consistent LBT failures on the one or more cells before transmission of the random access preamble or Msg A. For example, the wireless device may continue the first random access process (for beam failure recovery) if the wireless device has transmitted the Msg 3 and determines the consistent LBT failures on the one or more cells after transmitting the Msg 3. The wireless device may stop the first random access (for beam failure recovery) if the wireless device has not transmitted the Msg 3 and determines the consistent LBT failures on the one or more cells before transmission of the Msg 3.

[0300] In an example, the determining the beam failure on the first cell may be based on a beam failure instance counter/variable reaching a first value. The first value may be a beam failure instance max count value. The wireless device may receive a configuration parameter indicating the beam failure instance max count value. The wireless device may increment the beam failure instance counter/variable (e.g., BFI_COUNTER) based on receiving one or more indications/notifications of a beam failure instances from physical layer. In an example, the determining the beam failure indication on the first cell may be based on starting a beam failure detection timer based on receiving one or more notifications/indications of beam failure instances from physical layer. The wireless device may reset (e.g., reset to zero) the beam failure instance counter/variable based on the beam failure detection timer expiring.

[0301] In an example, the first random access process may be one of a two-step random access process and a four-step random access process. The second random access process may be one of a two-step random access process and four-step random access process. A two-step random access process may comprise two messages exchanged between the wireless device and the bae station

(e.g., Msg A and Msg B) and a four-step random access process may comprise four messages exchanged between the wireless device and the base station (e.g., Msg 1/preamble, Msg 2/RAR, Msg 3 and Msg 4). In an example, the configuration parameters may indicate whether the wireless device may start a two-step or a four-step random access process for consistent LBT failure recovery. In an example, the configuration parameters may indicate whether the wireless device may start a two-step or a four-step random access process for beam failure recovery. In an example, the wireless device may receive configuration parameters indicating one or more first random access parameters (e.g., one or first threshold values, one or more first prioritization parameters, one or more first power parameters (e.g., power ramping parameter) for calculating a preamble power, etc.) for a random access process for consistent LBT failure recovery. In an example, the wireless device may receive configuration parameters indicating one or more second random access parameters (e.g., one or second threshold values, one or more second prioritization parameters, one or more first power parameters (e.g., power ramping parameter) for calculating a preamble power, etc.) for a random access process for beam failure recovery.

[0302] In an example embodiment, a wireless device may start a first random access process on a primary cell based on determining consistent LBT failures on one or more cells. The wireless device may transmit a random access preamble based on determining the consistent LBT failure on one or more cells and starting the first random access process. In an example, the wireless device may transmit a Msg A based on determining consistent LBT failure on one or more cells and starting the first random access process (e.g., with two-step random access). The wireless device may determine a beam failure on a first cell. Based on the determining the beam failure: the wireless device may stop the first random access process; and the wireless device may start a second random access process on the primary cell for beam failure recovery. The wireless device may start the second random access process after stopping the first random access process.

[0303] In an example embodiment, a wireless device may start a first random access process on a primary cell based on determining consistent LBT failures on one or more cells. The wireless device may transmit a random access preamble based on determining the consistent LBT failure on one or more cells and starting the first random access process. In an example, the wireless device may transmit a Msg A based on determining the consistent LBT failure on one or more cells and starting the first random access process (e.g., with two-step random access). The wireless device may determine a beam failure on a first cell. Based on the determining the beam failure on the first

cell: the wireless device may continue the first random access process; and the wireless device may start a second random access process on the primary cell for beam failures recovery based on the first random access being successfully completed.

[0304] In an example, the one or more cells may with consistent LBT failures comprise the primary cell. In an example, the starting the first random access process on the primary cell may be based on the one or more cells with consistent LBT failures compromising the primary cell. In an example, based on the one or more cells with consistent LBT failures comprising the primary cell, the wireless device may switch from a first bandwidth part of the primary cell to a second bandwidth part of the primary cell and may start the first random access process on the second bandwidth part of the primary cell.

[0305] In an example, the wireless device may trigger an LBT failure indication due to determining the consistent LBT failures on the one or more cells. The wireless device may have no uplink resources being available for transmission of a consistent LBT failure indication MAC CE. In an example, no scheduling request resource for consistent LBT failure recovery may be configured for the wireless device. The wireless device may start the first random access process based on no scheduling request resource for consistent LBT failure recovery being configured for the wireless device.

[0306] In an example, the wireless device may trigger an LBT failure indication due to determining the consistent LBT failures on the one or more cells. The wireless device may have no uplink resources being available for transmission of a consistent LBT failure MAC CE. The wireless device may trigger scheduling request based on no uplink resources being available for transmission of a consistent LBT failure MAC CE. In an example, the wireless device may start the first random access process based on: transmitting scheduling request signals for consistent LBT failures recovery; and not receiving an uplink grant for transmission of a consistent LBT indication MAC CE.

[0307] In an example, the wireless device may start a third random access process on the primary cell for consistent LBT failure recovery based on the second random access process for beam failure recovery being successfully completed. The third random access process may be one of a two-step random access process or a four-step random access process.

[0308] In an example, the first cell with beam failure may be a primary cell. The wireless may start the second random access on the primary cell based on the first cell with beam failure being the primary cell.

[0309] In an example, the first cell with beam failure may be a secondary cell. The wireless device may trigger a beam failure recovery MAC CE based on the first cell with beam failure being a secondary cell. The wireless device may have no uplink resources available for transmission of the beam failure recovery MAC CE. The starting the second random access on the primary cell may be based on no scheduling request resource for beam failure recovery being configured for the wireless device.

[0310] In an example, the first cell with beam failure may be a secondary cell. The wireless device may trigger a beam failure recovery MAC CE based on the first cell with beam failure being a secondary cell. The wireless device may have no uplink resources available for transmission of the beam failure recovery MAC CE. The wireless device may trigger scheduling request and may transmit a plurality of scheduling request signals for beam failure recovery. The wireless device may not receive an uplink grant for transmission of a beam failure recovery MAC CE. The starting the second random access on the primary cell may be based on not receiving an uplink grant for transmission of a beam failure recovery MAC CE.

[0311] In an example embodiment, a wireless device may start a first random access process on a primary cell based on determining a beam failure on a first cell. The wireless device may transmit a random access preamble based on determining the beam failure on the first cell and starting the first random access process. In an example, the wireless device may transmit a Msg A based on determining the beam failure on the first cell and starting the random access process (e.g., with two-step random access). The wireless device may determine consistent LBT failures on one or more cells comprising the primary cell. Based on the determining: the wireless device may stop the first random access process; the wireless device may switch from the first bandwidth part of the primary cell to a second bandwidth part of the primary cell; and the wireless device may start a second random access process for beam failure recovery.

[0312] In an example, the wireless device may start a third random access on the primary cell for consistent LBT failure recovery based on the second random access process being successfully completed. In an example, the starting the third random access process on the primary cell may be based on the one or more cells with consistent LBT failures comprising the primary cell. In an

example, the wireless device may start the third random access on the second bandwidth part of the primary cell. The third random access process may be a two-step random access or a four-step random access.

[0313] In an example, the switching from the first bandwidth part of the primary cell to the second bandwidth part of the primary cell may be based on the one or more cells with consistent LBT failures comprising the primary cell.

[0314] In an example, the first cell with beam failure may be a primary cell. The wireless may start the first random access on the primary cell based on the first cell with beam failure being the primary cell.

[0315] In an example, the first cell with beam failure may be a secondary cell. The wireless device may trigger a beam failure recovery MAC CE based on the first cell with beam failure being a secondary cell. The wireless device may have no uplink resources available for transmission of the beam failure recovery MAC CE. The starting the first random access on the primary cell may be based on no scheduling request resource for beam failure recovery being configured for the wireless device.

[0316] In an example, the first cell with beam failure may be a secondary cell. The wireless device may trigger a beam failure recovery MAC CE based on the first cell with beam failure being a secondary cell. The wireless device may have no uplink resources available for transmission of the beam failure recovery MAC CE. The wireless device may trigger scheduling request and may transmit a plurality of scheduling request signals for beam failure recovery. The wireless device may not receive an uplink grant for transmission of a beam failure recovery MAC CE. The starting the first random access on the primary cell may be based on not receiving an uplink grant for transmission of a beam failure recovery MAC CE.

[0317] In an example embodiment, a wireless device may start a first random access process on a primary cell based on determining a beam failure on a first cell. The wireless device may transmit a random access preamble based on determining the beam failure on the first cell and starting the first random access process. In an example, the wireless device may transmit a Msg A based on determining the beam failure on the first cell and starting the random access process (e.g., with two-step random access). The wireless device may determine consistent LBT failures on one or more secondary cells. Based on the determining: the wireless device may continue the first random

access process; and the wireless device may start a second random access process for consistent LBT failures recovery based on the first random access process being successfully completed.

[0318] In an example, the wireless device may trigger consistent LBT failure indication. The wireless device may have no uplink resources available for transmission of a consistent LBT failure indication MAC CE. In an example, the starting the second random access process may be based on no scheduling request resource for consistent LBT failures recovery being configured for the wireless device.

[0319] In an example, the wireless device may trigger consistent LBT failure indication. The wireless device may have no uplink resources available for transmission of a consistent LBT failure indication MAC CE. The wireless device may trigger scheduling request based on no uplink resources being available for transmission of a consistent LBT failure indication MAC CE. The wireless device may start the second random access process based on transmitting scheduling request signals for consistent LBT failures recovery; and not receiving an uplink grant for transmission of a consistent LBT failure indication MAC CE.

[0320] In an example, the first cell with beam failure may be a primary cell. The wireless may start the first random access on the primary cell based on the first cell with beam failure being the primary cell.

[0321] In an example, the first cell with beam failure may be a secondary cell. The wireless device may trigger a beam failure recovery MAC CE based on the first cell with beam failure being a secondary cell. The wireless device may have no uplink resources available for transmission of the beam failure recovery MAC CE. The starting the first random access on the primary cell may be based on no scheduling request resource for beam failure recovery being configured for the wireless device.

[0322] In an example, the first cell with beam failure may be a secondary cell. The wireless device may trigger a beam failure recovery MAC CE based on the first cell with beam failure being a secondary cell. The wireless device may have no uplink resources available for transmission of the beam failure recovery MAC CE. The wireless device may trigger scheduling request and may transmit a plurality of scheduling request signals for beam failure recovery. The wireless device may not receive an uplink grant for transmission of a beam failure recovery MAC CE. The starting the first random access on the primary cell may be based on not receiving an uplink grant for transmission of a beam failure recovery MAC CE.

[0323] In an example embodiment, a wireless device may start a first random access process on a primary cell for beam failure recovery based on determining a beam failure on a first cell. The wireless device may transmit a random access preamble based on determining the beam failure on the first cell and starting the first random access process. In an example, the wireless device may transmit a Msg A based on determining the beam failure on the first cell and starting the random access process (e.g., with two-step random access). The wireless device may determine consistent LBT failures on one or more cells comprising the primary cell. Based on the determining: the wireless device may stop the first random access process; the wireless device may switch from a first bandwidth part of the primary cell to a second bandwidth part of the primary cell; the wireless device may start a second random access process, for consistent LBT failures recovery, on the second bandwidth part; and the wireless device may start a third random access process for beam failure recovery based on the second random access process being successfully completed.

[0324] In an example, the switching from the first bandwidth part of the primary cell to the second bandwidth part of the primary cell may be based on the one or more cells with consistent LBT failures comprising the primary cell. In an example, the starting the second random access process on the primary cell may be based on the one or more cells with consistent LBT failures comprising the primary cell.

[0325] In an example, the starting the third random access process may be on the second bandwidth part of the primary cell. In an example, the third random access may be one of a two-step random access and a four-step random access.

[0326] In an example, the first cell with beam failure may be a primary cell. The wireless may start the first random access on the primary cell based on the first cell with beam failure being the primary cell.

[0327] In an example, the first cell with beam failure may be a secondary cell. The wireless device may trigger a beam failure recovery MAC CE based on the first cell with beam failure being a secondary cell. The wireless device may have no uplink resources available for transmission of the beam failure recovery MAC CE. The starting the first random access on the primary cell may be based on no scheduling request resource for beam failure recovery being configured for the wireless device.

[0328] In an example, the first cell with beam failure may be a secondary cell. The wireless device may trigger a beam failure recovery MAC CE based on the first cell with beam failure being a

secondary cell. The wireless device may have no uplink resources available for transmission of the beam failure recovery MAC CE. The wireless device may trigger scheduling request and may transmit a plurality of scheduling request signals for beam failure recovery. The wireless device may not receive an uplink grant for transmission of a beam failure recovery MAC CE. The starting the first random access on the primary cell may be based on not receiving an uplink grant for transmission of a beam failure recovery MAC CE.

[0329] In an example embodiment, a wireless device may start a first random access process on a primary cell for beam failure recovery based on determining a beam failure on a first cell. The wireless device may transmit a random access preamble based on determining the beam failure on the first cell and starting the first random access process. In an example, the wireless device may transmit a Msg A based on determining the beam failure on the first cell and starting the random access process (e.g., with two-step random access). The wireless device may determine consistent LBT failures on one or more secondary cells. Based on the determining: the wireless device may stop the first random access process; the wireless device may start a second random access process for consistent LBT failures recovery; and the wireless device may start a third random access process, for consistent LBT failures recovery, based on the second random access process being successfully completed.

[0330] In an example, the wireless device may trigger an LBT failure indication based on the consistent LBT failures on the one or more secondary cells. The wireless device may be configured with no uplink resources for transmission of an LBT failures indication MAC CE. In an example, the starting the second random access process may be based on no scheduling request resource for consistent LBT failures recovery being configured for the wireless device.

[0331] In an example, the wireless device may trigger an LBT failure indication based on the consistent LBT failures on the one or more secondary cells. The wireless device may be configured with no uplink resources for transmission of an LBT failures indication MAC CE. The wireless device may trigger scheduling request. In an example, the starting the second random access process may be based on transmitting scheduling request signals for consistent LBT failures recovery; and not receiving an uplink grant for transmission of a consistent LBT failure indication MAC CE.

[0332] In an example, the first cell with beam failure may be a primary cell. The wireless may start the first random access on the primary cell based on the first cell with beam failure being the primary cell.

[0333] In an example, the first cell with beam failure may be a secondary cell. The wireless device may trigger a beam failure recovery MAC CE based on the first cell with beam failure being a secondary cell. The wireless device may have no uplink resources available for transmission of the beam failure recovery MAC CE. The starting the first random access on the primary cell may be based on no scheduling request resource for beam failure recovery being configured for the wireless device.

[0334] In an example, the first cell with beam failure may be a secondary cell. The wireless device may trigger a beam failure recovery MAC CE based on the first cell with beam failure being a secondary cell. The wireless device may have no uplink resources available for transmission of the beam failure recovery MAC CE. The wireless device may trigger scheduling request and may transmit a plurality of scheduling request signals for beam failure recovery. The wireless device may not receive an uplink grant for transmission of a beam failure recovery MAC CE. The starting the first random access on the primary cell may be based on not receiving an uplink grant for transmission of a beam failure recovery MAC CE.

[0335] In an example embodiment, a wireless device may start a first random access process on a primary cell for beam failure recovery based on determining a beam failure on a first cell. The wireless device may transmit a random access preamble based on determining the beam failure on the first cell and starting the first random access process. In an example, the wireless device may transmit a Msg A based on determining the beam failure on the first cell and starting the random access process (e.g., with two-step random access). The wireless device may determine consistent LBT failures on one or more cells comprising a primary cell. Based on the determining the consistent LBT failures: the wireless device may continue the first random access process; the wireless device may switch from a first bandwidth part of the primary cell to a second bandwidth part of the primary cell based on the first random access process being successfully completed; and the wireless device may start a second random access process for consistent LBT failures recovery on the second bandwidth part.

[0336] In an example embodiment, a wireless device may start a first random access process on a primary cell for beam failure recovery based on determining a beam failure on a first cell. The

wireless device may transmit a random access preamble based on determining the beam failure on the first cell and starting the first random access process. In an example, the wireless device may transmit a Msg A based on determining the beam failure on the first cell and starting the random access process (e.g., with two-step random access). The wireless device may determine consistent LBT failures on one or more secondary cells. Based on the determining the consistent LBT failures: the wireless device may continue the first random access process; and the wireless device may start a second random access process for consistent LBT failures recovery based on the first random access process being successfully completed.

[0337] In an example, the determining the beam failure on the first cell may be based on a beam failure detection counter reaching a first value. In an example, the determining the beam failure on the first cell may comprise incrementing a beam failure detection counter based on one or more notifications of beam failure instances from physical layer. In an example, the determining the beam failure on the first cell may comprise starting a beam failure detection timer based on one or more notifications of beam failure instances from physical layer. In an example, the determining the beam failure on the first cell may comprise comprises resetting a beam failure detection counter (e.g., resetting to zero) based on a beam failure detection timer expiring.

[0338] In an example, the first random access process may be one of a two-step random access or a four-step random access process; and the second random access process may be one of a two-step random access or a four-step random access process.

[0339] In an example, the wireless device may receive configuration parameters comprising: random access configuration parameters; beam failure detection and recovery configuration parameters; and consistent LBT failure detection and recovery configuration parameters. The random access configuration parameters may comprise one or more parameters indicating random access occasions on one or more bandwidth parts of the primary cell. The beam failure detection and recovery configuration parameters may comprise one or more second parameters (e.g., one or more counter and/or timer values) for detection of a beam failure based on a beam failure detection process and for recovery based on a beam failure recovery process. The consistent LBT failure detection and recovery configuration parameters may comprise one or more third parameters (e.g., one or more counter and/or timer values) for detection of consistent LBT failures on a cell based on a consistent LBT failures detection process and for recovery based on a consistent LBT failures recovery process.

[0340] Existing procedures for recovery from consistent listen before talk on a primary cell or recovery from beam failure on a primary cell may be based on initiation of a random access process. The existing procedures may not take into account the ongoing random access process processes when the recovery procedure is initiated and may lead to wireless device and network performance degradation, for example due to increased latency or inefficiency or failure of the recovery procedures. There is a need to enhance the existing consistent LBT failure recovery and/or beam failure recovery procedures. Example embodiments enhance the existing consistent LBT failure and/or beam failure recovery procedures.

[0341] In an example embodiment, a wireless device may receive one or more messages (e.g., one or more RRC messages) comprising configuration parameters. The configuration parameters may comprise serving cell configuration parameters of one or more cells. The one or more cells may comprise a primary cell. In an example, the one or more cells may comprise a primary cell and one or more secondary cells. In an example, the one or more cells may comprise an unlicensed cell or a cell that operates in unlicensed spectrum or shared spectrum. In an example, the primary cell may be an unlicensed cell or a cell that operates in unlicensed spectrum or shared spectrum. The uplink and/or downlink transmissions on a cell that operates in the unlicensed or shared spectrum may be based on a listen-before-talk (LBT) procedure, for the uplink and/or the downlink transmission, indicating that the channel is available for transmission. In an example, the one or more cells may be provided by one or more base stations, e.g., using a single-connectivity architecture or multi-connectivity architecture. In an example, a cell (e.g., the primary cell) in the one or more cells may operate using beamforming, for example, the cell may be associated with multiple beams. The configuration parameters may comprise first configuration parameters for beam failure recovery and second configuration parameters for LBT failure recovery. The wireless device may detect/determine/trigger and recover from beam failure based on the configuration parameters for beam failure recovery. The wireless device may detect/determine/trigger and recover from consistent LBT failure based on the configuration parameters for LBT failure recovery.

[0342] The configuration parameters for beam failure recovery may be based on a BeamFailureRecoveryConfig information element (IE) and/or a RadioLinkMonitoringConfig IE. The BeamFailureRecoveryConfig IE may be used to configure the UE with RACH resources and candidate beams for beam failure recovery in case of beam failure detection. The BeamFailureRecoveryConfig IE may comprise a plurality of fields/parameters. A

beamFailureRecoveryTimer field may indicate a timer for beam failure recovery timer. Upon expiration of the timer the UE may not use CFRA for beam failure recovery (BFR). A candidateBeamRSList field may indicate the list of reference signals (e.g., CSI-RS and/or SSB) identifying the candidate beams for recovery and the associated random access parameters. A msg1-SubcarrierSpacing field may indicate a subcarrier spacing for contention free beam failure recovery. A rsrp-ThresholdSSB field may indicate a L1-RSRP threshold used for determining whether a candidate beam may be used by the UE to attempt contention free random access to recover from beam failure. A ra-prioritization field may indicate parameters which may apply for prioritized random access procedure for BFR. A ra-PrioritizationTwoStep field may indicate parameters which may apply for prioritized 2-step random access procedure for BFR. A ra-ssb-OccasionMaskIndex field may indicate an explicitly signaled PRACH Mask Index for RA Resource selection. A rach-ConfigBFR field may indicate configuration of contention free random access occasions for BFR. A recoverySearchSpaceId field may indicate search space to use for BFR RAR, e.g., for reception of random access response (RAR) in random access process initiated for beam failure recovery. The network may configure this search space to be within the linked DL BWP (e.g., within the DL BWP with the same bwp-Id) of the UL BWP in which the BeamFailureRecoveryConfig is provided. In an example, the CORESET associated with the recovery search space may not be associated with another search space. The network may configure the UE with a value for this field when contention free random access resources for BFR are configured. A rootSequenceIndex-BFR field may indicate PRACH root sequence index for beam failure recovery. A ssb-perRACH-Occasion field may indicate a number of SSBs per RACH occasion for CF-BFR.

[0343] A RadioLinkMonitoringConfig IE may be used to configure radio link monitoring for detection of beam- and/or cell radio link failure. The RadioLinkMonitoringConfig IE may comprise a plurality of field. A beamFailureDetectionTimer field may indicate a timer for beam failure detection. A beamFailureInstanceMaxCount field may be used to determine after how many beam failure events the UE may trigger beam failure recovery. A failureDetectionResourcesToAddModList field may indicate a list of reference signals for detecting beam failure and/or cell level radio link failure (RLF).

[0344] The configuration parameters for LBT failure recovery may be based on an LBT-FailureRecoveryConfig IE. The LBT-FailureRecoveryConfig IE may be used to configure the

parameters used for detection of consistent uplink LBT failures for operation with shared spectrum channel access. The LBT-FailureRecoveryConfig IE may comprise a plurality of parameters/fields. An lbt-FailureDetectionTimer field may indicate a timer for consistent uplink LBT failure detection. An lbt-FailureInstanceMaxCount field may determine after how many consistent uplink LBT failure events the UE may trigger uplink LBT failure recovery.

[0345] In an example embodiment as shown in FIG. 34, the wireless device may detect a beam failure on a primary cell of the wireless device. The first configuration for beam failure recovery may comprise a first parameter (e.g., beamFailureInstanceMaxCount) indicating a first number of beam failure instances that triggers beam failure recovery. The detection of the beam failure may be based on a beam failure instance indication counter reaching the first number. In an example, the wireless device may increment the beam failure instance indication counter by one based on a beam failure indication, for example reception of the beam failure indication by a MAC layer of the wireless device from a physical layer of the wireless device. The wireless device may start or restart a beam failure detection timer in response to the beam failure indication, e.g., reception of the beam failure indication by the MAC layer from the physical layer. The wireless device may set the beam failure instance indication counter to zero (e.g., reset the beam failure instance indication counter) based on the beam failure detection timer expiring. In response to the detection of the beam failure on the primary cell, the wireless device may initiate a first random access process on a first BWP of the primary cell. The first BWP of the primary cell may be the current active BWP (e.g., the active BWP of the primary cell when the wireless device detects the beam failure on the primary cell) of the primary cell. The wireless device may initiate the first random access process on the first BWP of the primary cell for beam failure recovery.

[0346] The wireless device may trigger consistent LBT failure for the primary cell. The wireless device may trigger the consistent LBT failure for the primary cell while the first random access process for beam failure recovery is ongoing on the primary cell. The triggering of the consistent LBT failure may be for the first BWP of the primary cell and/or based on failure of LBT procedures for uplink transmissions on the first BWP of the primary cell. The second configuration for LBT failure recovery may comprise a first parameter (e.g., FailureInstanceMaxCount) indicating a first number of LBT failure instances that triggers LBT failure recovery. The triggering of the consistent LBT failure may be based on an LBT failure indication counter reaching the first number. In an example, the wireless device may increment the LBT failure indication counter by

one based on an LBT failure indication, for example reception of the LBT failure indication by a MAC layer of the wireless device from a physical layer of the wireless device. The wireless device may start or restart an LBT failure detection timer in response to the LBT failure indication, e.g., reception of the LBT failure indication by the MAC layer from the physical layer. The wireless device may set the LBT failure indication counter to zero (e.g., may reset the LBT failure indication counter) based on the LBT failure detection timer expiring.

[0347] In response to the triggering of the consistent LBT failure for the primary cell, the wireless device may stop the first random access procedure, for beam failure recovery, on the primary cell (the first BWP of the primary cell). In an example, stopping the first random access process may comprise resetting counter(s) and/or timer(s) and/or variable(s) associated with the first random access process. The wireless device may switch from the first BWP of the primary cell to a second BWP of the primary cell. In an example, the one or more messages may comprise bandwidth part configuration parameters of a plurality of BWPs, comprising the first BWP and the second BWP, of the primary cell. The bandwidth part configuration parameters of the second BWP of the primary cell may comprise random access parameters for the second BWP of the primary cell, indicating that the second BWP of the primary cell is configured with random access occasions/resources. The switching, by the wireless device, from the first BWP of the primary cell to the second BWP of the primary cell may be based on the second BWP of the primary cell being configured with random access resources/occasion. In an example, one or more BWPs of the primary cell may be configured with random access resources/occasions and the selection of the second BWP, in the one or more BWPs, for switching from the first BWP, may be based on one or more criteria. The wireless device may initiate a second random access process on the second BWP of the primary cell. The wireless device may initiate the second random access process in the second BWP of primary cell based on the random access parameters configured for the second BWP of the primary cell and using the random access occasions/resources configured for the second BWP of the primary cell.

[0348] In an example, the second random access process, on the second BWP of the primary cell, may be for consistent LBT failure recovery. The wireless device may initiate a third random access process on the second BWP of the primary cell, for beam failure recovery, after completion (e.g., successful completion) of the second random access process for consistent LBT failure recovery. The second random access process, for consistent LBT failure recovery, may be based on random

access process configuration parameters. The random access process configuration parameters, used for consistent LBT failure recovery, may be commonly configured for different random access processes not including random access processes performed for beam failure recovery. In an example, the random access parameters for beam failure recovery may be separately configured. For example, the first configuration parameters, for beam failure recovery, may comprise first random access parameters. The one or more messages, received by the wireless device, may comprise second random access process different from the first random access parameters. The first random access process, for beam failure recovery may be based on the first random access parameters and the second random access process for consistent LBT failure may be based on the second random access parameters. For example, the first random access parameters, for beam failure recovery, may indicate random access resources/occasions to be used for a random access process that is initiated for beam failure recovery. For example, the first random access parameters, for beam failure recovery, may indicate a random access response window for beam failure recovery, a first number of preamble transmissions before declaring a random access failure for beam failure recovery, a power ramping step for a beam failure recovery random access process, a configuration index for beam failure recovery, etc. The second random access process, for consistent LBT failure recovery, may comprise transmitting a transport block (TB), e.g., via a Msg3 message (in a four-step random access process) or a MsgA message (in a two-step random access process). The TB may comprise an LBT failure MAC CE. The LBT failure MAC CE may have one of a short format (one octet) and long format (four octets) depending on highest ServingCellIndex of the serving cells configured for the wireless device (e.g., the one-octet format when the highest ServingCellIndex is less than eight and the four-octet format otherwise). The LBT failure MAC CE may indicate for which serving cell(s) the consistent LBT failure is triggered. The wireless device may multiplex the LBT failure MAC CE with other logical channel(s) and/or MAC CE(s) in the TB. The multiplexing of the LBT failure MAC CE with other logical channel(s) and/or MAC CE(s) may be based on a logical channel prioritization procedure. The logical channel prioritization procedure may utilize the priorities of logical channel(s) and MAC CE(s). For the purpose of the logical channel prioritization procedure, the priority of the LBT failure MAC CE may be higher than the priorities of data from any logical channel except uplink common control channel (UL-CCCH) logical channel.

[0349] In an example, the second random access process, on the second BWP of the primary cell, may be for beam failure recovery. The wireless device may initiate a third random access process on the second BWP of the primary cell, for consistent LBT failure recovery, after completion (e.g., successful completion) of the second random access process for beam failure recovery. The second random access process, for beam failure recovery, may be based on random access process configuration parameters configured for beam failure recovery. The second random access process may comprise transmitting a transport block (TB), e.g., via a Msg3 message (in a four-step random access process) or a MsgA message (in a two-step random access process). The TB may comprise a beam failure recovery (BFR) MAC CE. The BFR MAC CE may have one of a short format (one octet) and long format (four octets) depending on highest ServingCellIndex of the serving cells configured for the wireless device (e.g., the one-octet format when the highest ServingCellIndex is less than eight and the four-octet format otherwise). The BFR MAC CE may indicate on which serving cell(s) the beam failure is detected. The wireless device may multiplex the BFR MAC CE with other logical channel(s) and/or MAC CE(s) in the TB. The multiplexing of the BFR MAC CE with other logical channel(s) and/or MAC CE(s) may be based on a logical channel prioritization procedure. The logical channel prioritization procedure may utilize the priorities of logical channel(s) and MAC CE(s). For the purpose of the logical channel prioritization procedure, the priority of the BFR MAC CE may be higher than the priorities of data from any logical channel except uplink common control channel (UL-CCCH) logical channel.

[0350] In an example embodiment as shown in FIG. 35, a wireless device may initiate a first random access process in a first BWP of a primary cell. The first random access process may be initiated/triggered based on a triggering event such as scheduling request failure (e.g., a scheduling request counter reaching a maximum value and receiving no uplink grant), establishing time alignment for a secondary timing advance group (TAG), beam failure recovery, etc. The wireless may trigger consistent LBT failure for the primary cell. The triggering of the consistent LBT failure for the primary cell may be based on an LBT failure indication counter reaching a first number (e.g., determined based on an RRC configured parameter e.g., FailureInstanceMaxCount) as described above. In response to the triggering of the consistent LBT failure for the primary cell, the wireless device may stop the first random access process. In an example, stopping the first random access process may comprise resetting counter(s) and/or timer(s) and/or variable(s) associated with the first random access process. The wireless device may switch from the first BWP of the primary

cell to a second BWP of the primary cell. In an example, the one or more messages may comprise bandwidth part configuration parameters of a plurality of BWPs, comprising the first BWP and the second BWP, of the primary cell. The bandwidth part configuration parameters of the second BWP of the primary cell may comprise random access parameters for the second BWP of the primary cell, indicating that the second BWP of the primary cell is configured with random access occasions/resources. The switching, by the wireless device, from the first BWP of the primary cell to the second BWP of the primary cell may be based on the second BWP of the primary cell being configured with random access resources/occasion. In an example, one or more BWPs of the primary cell may be configured with random access resources/occasions and the selection of the second BWP, in the one or more BWPs, for switching from the first BWP, may be based on one or more criteria. The wireless device may initiate a second random access process on the second BWP of the primary cell. The wireless device may initiate the second random access process in the second BWP of primary cell based on the random access parameters configured for the second BWP of the primary cell and using the random access occasions/resources configured for the second BWP of the primary cell. In an example, the second random access process, on the second BWP of the primary cell, may be for consistent LBT failure recovery.

[0351] In an example embodiment as shown in FIG. 36, a wireless device may trigger consistent LBT failures for a primary cell. The triggering of the consistent LBT failure may be based on LBT failure recovery configuration parameters. The triggering of the consistent LBT failure may be based on failure of LBT procedures for uplink transmissions on the primary cell. The configuration parameters for LBT failure recovery may comprise a first parameter (e.g., FailureInstanceMaxCount) indicating a first number of LBT failure instances that triggers LBT failure recovery. The triggering of the consistent LBT failure may be based on an LBT failure indication counter reaching the first number. In an example, the wireless device may increment the LBT failure indication counter by one based on an LBT failure indication, for example reception of the LBT failure indication by a MAC layer of the wireless device from a physical layer of the wireless device. The wireless device may start or restart an LBT failure detection timer in response to the LBT failure indication, e.g., reception of the LBT failure indication by the MAC layer from the physical layer. The wireless device may set the LBT failure indication counter to zero (e.g., may reset the LBT failure indication counter) based on the LBT failure detection timer expiring.

[0352] In response to the triggering of the consistent LBT failure for the primary cell, the wireless device may initiate a first random access on the primary cell for consistent LBT failure recovery. The first random access process, for consistent LBT failure recovery, may be based on random access process configuration parameters. The random access process configuration parameters, used for consistent LBT failure recovery, may be commonly configured for different random access processes not including random access processes performed for beam failure recovery. In an example, the random access parameters for beam failure recovery may be separately configured.

[0353] The wireless device may detect a beam failure on the primary cell of the wireless device. In an example, the detection of the beam failure on the primary cell may be while the first random access process for the consistent LBT failure recovery is ongoing. The configuration for beam failure recovery may comprise a first parameter (e.g., beamFailureInstanceMaxCount) indicating a first number of beam failure instances that triggers beam failure recovery. The detection of the beam failure may be based on a beam failure instance indication counter reaching the first number. In an example, the wireless device may increment the beam failure instance indication counter by one based on a beam failure indication, for example reception of the beam failure indication by a MAC layer of the wireless device from a physical layer of the wireless device. The wireless device may start or restart a beam failure detection timer in response to the beam failure indication, e.g., reception of the beam failure indication by the MAC layer from the physical layer. The wireless device may set the beam failure instance indication counter to zero (e.g., reset the beam failure instance indication counter) based on the beam failure detection timer expiring.

[0354] Based on the detection of the beam failure, the wireless device may stop the first random access process for consistent LBT failure. In an example, stopping the first random access process may comprise resetting counter(s) and/or timer(s) and/or variable(s) associated with the first random access process. The wireless device may initiate a second random access process on the primary cell for beam failure recovery. The wireless device may initiate/perform the second random access process based on random access process configuration parameters configured for beam failure recovery. The configuration parameters for beam failure recovery may comprise random access parameters configured for beam failure recovery. The random access parameters for beam failure recovery may indicate random access resources/occasions to be used for a random access process that is initiated for beam failure recovery. For example, the random access parameters for beam failure recovery may indicate a random access response window for beam

failure recovery, a first number of preamble transmissions before declaring a random access failure for beam failure recovery, a power ramping step for a beam failure recovery random access process, a configuration index for beam failure recovery, etc. The second random access process may comprise transmitting a transport block (TB), e.g., via a Msg3 message (in a four-step random access process) or a MsgA message (in a two-step random access process). The TB may comprise a beam failure recovery (BFR) MAC CE. The BFR MAC CE may have one of a short format (one octet) and long format (four octets) depending on highest ServingCellIndex of the serving cells configured for the wireless device (e.g., the one-octet format when the highest ServingCellIndex is less than eight and the four-octet format otherwise). The BFR MAC CE may indicate on which serving cell(s) the beam failure is detected. The wireless device may multiplex the BFR MAC CE with other logical channel(s) and/or MAC CE(s) in the TB. The multiplexing of the BFR MAC CE with other logical channel(s) and/or MAC CE(s) may be based on a logical channel prioritization procedure. The logical channel prioritization procedure may utilize the priorities of logical channel(s) and MAC CE(s). For the purpose of the logical channel prioritization procedure, the priority of the BFR MAC CE may be higher than the priorities of data from any logical channel except uplink common control channel (UL-CCCH) logical channel.

[0355] In an example, the wireless device may initiate a third random access process for the consistent LBT failure recovery after the second random access process is completed (e.g., successfully completed). The third random access process, for consistent LBT failure recovery, may comprise transmitting a transport block (TB), e.g., via a Msg3 message (in a four-step random access process) or a MsgA message (in a two-step random access process). The TB may comprise an LBT failure MAC CE. The LBT failure MAC CE may have one of a short format (one octet) and long format (four octets) depending on highest ServingCellIndex of the serving cells configured for the wireless device (e.g., the one-octet format when the highest ServingCellIndex is less than eight and the four-octet format otherwise). The LBT failure MAC CE may indicate for which serving cell(s) the consistent LBT failure is triggered. The wireless device may multiplex the LBT failure MAC CE with other logical channel(s) and/or MAC CE(s) in the TB. The multiplexing of the LBT failure MAC CE with other logical channel(s) and/or MAC CE(s) may be based on a logical channel prioritization procedure. The logical channel prioritization procedure may utilize the priorities of logical channel(s) and MAC CE(s). For the purpose of the logical channel prioritization procedure, the priority of the LBT failure MAC CE may be higher than the priorities

of data from any logical channel except uplink common control channel (UL-CCCH) logical channel.

[0356] In an example embodiment as shown in FIG. 37, the wireless device may initiate a first random access process on the primary cell in response to triggering consistent LBT failure for the primary cell. The triggering the consistent LBT failure for the primary cell may be based on the LBT failure recovery configuration parameters and based on an LBT failure instance indication counter reaching a first number (e.g., as indicated by the LBT failure recovery configuration parameters such as a FailureInstanceMaxCount parameter). The wireless device may detect beam failure for the primary cell, e.g., while the first random access process for consistent LBT failure recovery is ongoing. The wireless device may detect the beam failure for the primary cell based on the configuration parameters for beam failure recovery and/or radio link monitoring. In response to the detecting the beam failure, the wireless device may continue the first random access process, for the consistent LBT failure recovery, and may initiate a second random access process, for beam failure recovery after the first random access process being completed (e.g., being successfully completed).

[0357] In an example embodiment as shown in FIG. 38, the wireless device may initiate a first random access process on the primary cell in response to detecting beam failure for the primary cell. The triggering the beam failure recovery for the primary cell may be based on the beam failure recovery configuration parameters and based on a beam failure indication counter reaching a first number (e.g., as indicated by the beam failure recovery configuration parameters such as a beamFailureInstanceMaxCount parameter). The wireless device may trigger consistent failure for the primary cell, e.g., while the first random access process for beam failure recovery is ongoing. The wireless device may trigger the consistent LBT failure for the primary cell based on the configuration parameters for LBT failure recovery. In response to the triggering the consistent LBT failure, the wireless device may continue the first random access process, for the consistent LBT failure recovery, and may initiate a second random access process, for beam failure recovery after the first random access process being completed (e.g., being successfully completed). In an example, the wireless device may switch from a first BWP of the primary cell (e.g., the active BWP of the primary cell on which the first random access process, for beam failure recovery, is initiated and for which the consistent LBT failure is triggered) to a second BWP of the primary cell based on the first random access process for beam failure recovery being successfully completed.

[0358] In an example embodiment as shown in FIG. 39, the wireless device may initiate a first random access process on the primary cell in response to detecting beam failure for the primary cell and for beam failure recovery. The triggering the beam failure recovery for the primary cell may be based on the beam failure recovery configuration parameters and based on a beam failure indication counter reaching a first number (e.g., as indicated by the beam failure recovery configuration parameters such as a beamFailureInstanceMaxCount parameter). The wireless device may trigger consistent failure for the primary cell, e.g., while the first random access process, for beam failure recovery, is ongoing. The wireless device may trigger the consistent LBT failure for the primary cell based on the configuration parameters for LBT failure recovery. In response to the triggering the consistent LBT failure, the wireless device may continue or stop the first random access process, for the consistent LBT failure recovery based on a stage of the first random access process for beam failure recovery, for example based on whether random access resources are selected and/or based on whether a random access message (e.g., a MsgA in a two-step random access process; or a Msg1/preamble or a Msg3 in a four-step random access process) is transmitted or based on a random access message (e.g., a MsgB in a two-step random access process; or a Msg2/RAR or Msg4 in a four-step random access process) is received.

[0359] In accordance with various exemplary embodiments in the present disclosure, a device (e.g., a wireless device, a base station and/or alike) may include one or more processors and may include memory that may store instructions. The instructions, when executed by the one or more processors, cause the device to perform actions as illustrated in the accompanying drawings and described in the specification. The order of events or actions, as shown in a flow chart of this disclosure, may occur and/or may be performed in any logically coherent order. In some examples, at least two of the events or actions shown may occur or may be performed at least in part simultaneously and/or in parallel. In some examples, one or more additional events or actions may occur or may be performed prior to, after, or in between the events or actions shown in the flow charts of the present disclosure.

[0360] FIG. 40 shows an example flow diagram in accordance with several of various embodiments of the present disclosure. At 4010, a wireless device may receive one or more messages comprising: first configuration parameters for beam failure recovery; and second configuration parameters for listen-before-talk (LBT) failure recovery. At 4020, the wireless device may initiate, based on the first configuration parameters and in response to detecting a beam failure

on a primary cell, a first random access process on a first bandwidth part (BWP) of the primary cell for beam failure recovery. At 4030, the wireless device may trigger, based on the second configuration parameters, consistent LBT failure for the primary cell. At 4040, the wireless device may stop the first random access process, for the beam failure recovery, based on the triggering the consistent LBT failure. At 4050, the wireless device may switch from the first BWP of the primary cell to a second BWP of the primary cell as an active BWP of the primary cell. At 4060, the wireless device may initiate a second random access process on the second BWP of the primary cell.

[0361] In an example embodiment, the second random access process, initiated at 4060, may be for consistent LBT failure recovery. In an example embodiment, the wireless device may initiate a third random access process, for the beam failure recovery, after the second random access process is successfully completed. In an example, embodiment, the second random access process, initiated at 4060, may comprise transmitting a transport block comprising an LBT failure medium access control (MAC) control element (CE). In an example embodiment, the transmitting the transport block may be based on a logical channel prioritization procedure. A first priority associated with the LBT failure MAC CE may be higher than a second priority associated with data from any logical channel except uplink common control channel (UL-CCCH) logical channel.

[0362] In an example embodiment, the second random access process, initiated at 4060, may be for the beam failure recovery. In an example embodiment, the wireless device may initiate a third random access process for consistent LBT failure recovery after the second random access process is successfully completed. In an example embodiment, the second random access process, initiated at 4060, may comprise transmitting a transport block comprising a beam failure recovery medium access control (MAC) control element (CE). In an example embodiment, the transmitting the transport block may be based on a logical channel prioritization procedure. A first priority associated with the beam failure recovery MAC CE may be higher than a second priority associated with data from any logical channel except uplink common control channel (UL-CCCH) logical channel.

[0363] In an example embodiment, the first configuration parameters, received at 4010 for beam failure recovery, may comprise first random access parameters. The one or more messages, received at 4010, may further comprise second random access parameters. The first random access process, initiated at 4020 for the beam failure recovery, may be based on the first random access

parameters. The second random access process, initiated at 4060, may be for consistent LBT failure recovery and may be based on the second random access parameters. In an example embodiment, the first random access parameters may indicate random access resources for a beam failure recovery random access process. In an example embodiment, the first random access parameters may indicate: a random access response window for beam failure recovery; a first number of preamble transmissions before declaring a random access failure for beam failure recovery; a power ramping step for a beam failure recovery random access process; and a configuration index for beam failure recovery.

[0364] In an example embodiment, the first configuration parameters, received at 4010 for beam failure recovery, may comprise an identifier of a search space for monitoring a control channel in a beam failure recovery random access process.

[0365] In an example embodiment, the first configuration parameters, received at 4010, may comprise a first parameter indicating a first number of beam failure instances that triggers beam failure recovery. The detecting the beam failure may be based on a beam failure instance indication counter reaching the first number. In an example embodiment, the detecting the beam failure at 4020 may comprise incrementing the beam failure instance indication counter by one based on a beam failure indication. In an example embodiment, the detecting the beam failure at 4020 may comprise setting the beam failure instance indication counter to zero based on a beam failure detection timer expiring.

[0366] In an example embodiment, the second configuration parameters, received at 4010, may comprise a first parameter indicating a first number of LBT failure instances that triggers LBT failure recovery. The triggering the consistent LBT failure, at 4030, may be based on an LBT failure indication counter reaching the first number. In an example embodiment, the triggering the consistent LBT failure, at 4030, may comprise incrementing the LBT failure indication counter by one based on an LBT failure indication. In an example embodiment, triggering the consistent LBT failure at 4030 may comprise setting the LBT failure indication counter to zero based on an LBT failure detection timer expiring.

[0367] In an example embodiment, the second BWP of the primary cell, on which the second random access process is initiated at 4060, may be configured with random access occasions. The switching, at 4050, from the first BWP of the primary cell to a second BWP of the primary cell

may be based on the second BWP of the primary cell being configured with the random access occasions.

[0368] FIG. 41 shows an example flow diagram in accordance with several of various embodiments of the present disclosure. At 4110, a wireless device may initiate a first random access process on a first bandwidth part (BWP) of a primary cell for beam failure recovery. At 4120, the wireless device may trigger consistent listen-before-talk (LBT) failure for the primary cell. At 4130, the wireless device may stop the first random access process based on the triggering the consistent LBT failure. At 4140, the wireless device may switch from the first BWP of the primary cell to a second BWP of the primary cell as an active BWP of the primary cell. At 4150, the wireless device may initiate a second random access process on the second BWP of the primary cell.

[0369] FIG. 42 shows an example flow diagram in accordance with several of various embodiments of the present disclosure. At 4210, a wireless device may initiate a first random access process on a first bandwidth part (BWP) of a primary cell. At 4220, the wireless device may trigger consistent listen-before-talk (LBT) failure for the primary cell. At 4230, the wireless device may stop the first random access process based on the triggering the consistent LBT failure. At 4240, the wireless device may switch from the first BWP of the primary cell to a second BWP of the primary cell as an active BWP of the primary cell. At 4250, the wireless device may initiate a second random access process on the second BWP of the primary cell.

[0370] In an example embodiment, the second random access process, initiated at 4250, may be for consistent LBT failure recovery.

[0371] FIG. 43 shows an example flow diagram in accordance with several of various embodiments of the present disclosure. At 4310, a wireless device may receive one or more messages comprising: first configuration parameters for listen-before-talk (LBT) failure recovery; and second configuration parameters for beam failure recovery. At 4320, the wireless device may trigger consistent LBT failure for a primary cell based on the first configuration parameters. At 4330, the wireless device may initiate, in response to the triggering the consistent LBT failure, a first random access process on the primary cell for consistent LBT failure recovery. At 4340, the wireless device may detect, based on the second configuration parameters, a beam failure for the primary cell. At 4350, the wireless device may stop the first random access process, for the

consistent LBT failure recovery, based on the detecting the beam failure. At 4360, the wireless device may initiate a second random access process on the primary cell for beam failure recovery.

[0372] In an example embodiment, the wireless device may initiate a third random access process for the consistent LBT failure recovery after the second random access process, initiated at 4360, is successfully completed. In an example embodiment, the third random access process may comprise transmitting a transport block comprising an LBT failure medium access control (MAC) control element (CE). In an example embodiment, the transmitting the transport block may be based on a logical channel prioritization procedure. A first priority associated with the LBT failure recovery MAC CE may be higher than a second priority associated with data from any logical channel except uplink common control channel (UL-CCCH) logical channel.

[0373] In an example embodiment, the second random access process, initiated at 4360, may comprise transmitting a transport block comprising a beam failure recovery medium access control (MAC) control element (CE). In an example embodiment, the transmitting the transport block may be based on a logical channel prioritization procedure. A first priority associated with the beam failure recovery MAC CE may be higher than a second priority associated with data from any logical channel except uplink common control channel (UL-CCCH) logical channel.

[0374] In an example embodiment, the second configuration parameters, received at 4310 for beam failure recovery, may comprise first random access parameters. The one or more messages, received at 4310, may further comprise second random access parameters. The first random access process, initiated at 4330 for the LBT failure recovery, may be based on the second random access parameters. The second random access process, initiated at 4360 for the beam failure recovery, may be based on the first random access parameters. In an example embodiment, the first random access parameters may indicate random access resources for a beam failure recovery random access process. In an example embodiment, the first random access parameters may indicate: a random access response window for beam failure recovery; a first number of preamble transmissions before declaring a random access failure for beam failure recovery; a power ramping step for a beam failure recovery random access process; and a configuration index for beam failure recovery.

[0375] In an example embodiment, the second configuration parameters, received at 4310 for beam failure recovery, may comprise an identifier of a search space for monitoring a control channel in a beam failure recovery random access process.

[0376] In an example embodiment, the second configuration parameters, received at 4310, may comprise a first parameter indicating a first number of beam failure instances that triggers beam failure recovery. The detecting the beam failure, at 4340, may be based on a beam failure instance indication counter reaching the first number. In an example embodiment, the detecting the beam failure, at 4340, may comprise incrementing the beam failure instance indication counter by one based on a beam failure indication. In an example embodiment, the detecting the beam failure, at 4340, may comprise setting the beam failure instance indication counter to zero based on a beam failure detection timer expiring.

[0377] In an example embodiment, the first configuration parameters, received at 4310, may comprise a first parameter indicating a first number of LBT failure instances that triggers LBT failure recovery. The triggering the consistent LBT failure, at 4320, may be based on an LBT failure indication counter reaching the first number. In an example embodiment, the triggering the consistent LBT failure, at 4320, may comprise incrementing the LBT failure indication counter by one based on an LBT failure indication. In an example embodiment, the triggering the consistent LBT failure, at 4320, may comprise setting the LBT failure indication counter to zero based on an LBT failure detection timer expiring.

[0378] FIG. 44 shows an example flow diagram in accordance with several of various embodiments of the present disclosure. At 4410, a wireless device may receive may initiate, in response to triggering consistent listen-before-talk (LBT) failure for a primary cell, a first random access process on the primary cell for consistent LBT failure recovery. At 4420, the wireless device may detect a beam failure for the primary cell. At 4430, the wireless device may stop the first random access process, for the consistent LBT failure recovery, based on the detecting the beam failure. At 4440, the wireless device may initiate a second random access process on the primary cell for beam failure recovery.

[0379] FIG. 45 shows an example flow diagram in accordance with several of various embodiments of the present disclosure. At 4510, a wireless device may initiate, in response to triggering consistent listen-before (LBT) failure for a primary cell, a first random access process on the primary cell for consistent LBT failure recovery. At 4520, the wireless device may detect a beam failure for the primary cell. At 4530, based on the detecting the beam failure: the wireless device may continue the first random access process; and the wireless device may initiate a second

random access process on the primary cell for beam failure recovery based on the first random access process being successfully completed.

[0380] In an example embodiment, the detecting the beam failure at 4520 may be while the first random access process is ongoing.

[0381] FIG. 46 shows an example flow diagram in accordance with several of various embodiments of the present disclosure. At 4610, a wireless device may initiate, in response to detecting beam failure for a primary cell, a first random access process on the primary cell for beam failure recovery. At 4620, the wireless device may trigger a consistent listen-before-talk (LBT) failure for the primary cell. At 4630, based on the triggering the consistent LBT failure: the wireless device may continue the first random access process; and the wireless device may initiate a second random access process on the primary cell for consistent LBT failure recovery based on the first random access process being successfully completed.

[0382] In an example embodiment, the wireless device may switch from a first bandwidth part (BWP) of the primary cell to a second BWP of the primary cell based on the first random access process being successfully completed.

[0383] FIG. 47 shows an example flow diagram in accordance with several of various embodiments of the present disclosure. At 4710, a wireless device may initiate, in response to detecting beam failure for a primary cell, a first random access process on the primary cell for beam failure recovery. At 4720, the wireless device may trigger a consistent listen-before-talk (LBT) failure for the primary cell. At 4730, the wireless device may stop or continue the first random access process, for beam failure recovery, based on a stage of the first random access process.

[0384] In an example embodiment, the wireless device may initiate a second random access process on the primary cell for consistent LBT failure recovery.

[0385] In an example embodiment, wherein the stopping or the continuing the first random access process, at 4730, may be based on whether a random access message is transmitted. In an example embodiment, the random access message may be one of a Msg1 message or a Msg3 message. In an example embodiment, the random access message may be a MsgA message.

[0386] In an example embodiment, the stopping or the continuing the first random access process may be based on whether a random access message is received. In an example embodiment, the random access message may be one of a Msg2 or a Msg4 message. In an example embodiment, the random access message may be a MsgB message.

[0387] Various exemplary embodiments of the disclosed technology are presented as example implementations and/or practices of the disclosed technology. The exemplary embodiments disclosed herein are not intended to limit the scope. Persons of ordinary skill in the art will appreciate that various changes can be made to the disclosed embodiments without departure from the scope. After studying the exemplary embodiments of the disclosed technology, alternative aspects, features and/or embodiments will become apparent to one of ordinary skill in the art. Without departing from the scope, various elements or features from the exemplary embodiments may be combined to create additional embodiments. The exemplary embodiments are described with reference to the drawings. The figures and the flowcharts that demonstrate the benefits and/or functions of various aspects of the disclosed technology are presented for illustration purposes only. The disclosed technology can be flexibly configured and/or reconfigured such that one or more elements of the disclosed embodiments may be employed in alternative ways. For example, an element may be optionally used in some embodiments or the order of actions listed in a flowchart may be changed without departure from the scope.

[0388] An example embodiment of the disclosed technology may be configured to be performed when deemed necessary, for example, based on one or more conditions in a wireless device, a base station, a radio and/or core network configuration, a combination thereof and/or alike. For example, an example embodiment may be performed when the one or more conditions are met. Example one or more conditions may be one or more configurations of the wireless device and/or base station, traffic load and/or type, service type, battery power, a combination of thereof and/or alike. In some scenarios and based on the one or more conditions, one or more features of an example embodiment may be implemented selectively.

[0389] In this disclosure, the articles “a” and “an” used before a group of one or more words are to be understood as “at least one” or “one or more” of what the group of the one or more words indicate. The use of the term “may” before a phrase is to be understood as indicating that the phrase is an example of one of a plurality of useful alternatives that may be employed in an embodiment in this disclosure.

[0390] In this disclosure, an element may be described using the terms “comprises”, “includes” or “consists of” in combination with a list of one or more components. Using the terms “comprises” or “includes” indicates that the one or more components are not an exhaustive list for the description of the element and do not exclude components other than the one or more components. Using the

term “consists of” indicates that the one or more components is a complete list for description of the element. In this disclosure, the term “based on” is intended to mean “based at least in part on”. The term “based on” is not intended to mean “based only on”. In this disclosure, the term “and/or” used in a list of elements indicates any possible combination of the listed elements. For example, “X, Y, and/or Z” indicates X; Y; Z; X and Y; X and Z; Y and Z; or X, Y, and Z.

[0391] Some elements in this disclosure may be described by using the term “may” in combination with a plurality of features. For brevity and ease of description, this disclosure may not include all possible permutations of the plurality of features. By using the term “may” in combination with the plurality of features, it is to be understood that all permutations of the plurality of features are being disclosed. For example, by using the term “may” for description of an element with four possible features, the element is being described for all fifteen permutations of the four possible features. The fifteen permutations include one permutation with all four possible features, four permutations with any three features of the four possible features, six permutations with any two features of the four possible features and four permutations with any one feature of the four possible features.

[0392] Although mathematically a set may be an empty set, the term set used in this disclosure is a nonempty set. Set B is a subset of set A if every element of set B is in set A. Although mathematically a set has an empty subset, a subset of a set is to be interpreted as a non-empty subset in this disclosure. For example, for set A={subcarrier1, subcarrier2}, the subsets are {subcarrier1}, {subcarrier2} and {subcarrier1, subcarrier2}.

[0393] In this disclosure, the phrase “based on” may be used equally with “based at least on” and what follows “based on” or “based at least on” indicates an example of one of plurality of useful alternatives that may be used in an embodiment in this disclosure. The phrase “in response to” may be used equally with “in response at least to” and what follows “in response to” or “in response at least to” indicates an example of one of plurality of useful alternatives that may be used in an embodiment in this disclosure. The phrase “depending on” may be used equally with “depending at least on” and what follows “depending on” or “depending at least on” indicates an example of one of plurality of useful alternatives that may be used in an embodiment in this disclosure. The phrases “employing” and “using” and “employing at least” and “using at least” may be used equally in this in this disclosure and what follows “employing” or “using” or “employing at least” or “using at least” indicates an example of one of plurality of useful alternatives that may be used in an embodiment in this disclosure.

[0394] The example embodiments disclosed in this disclosure may be implemented using a modular architecture comprising a plurality of modules. A module may be defined in terms of one or more functions and may be connected to one or more other elements and/or modules. A module may be implemented in hardware, software, firmware, one or more biological elements (e.g., an organic computing device and/or a neurocomputer) and/or a combination thereof and/or alike. Example implementations of a module may be as software code configured to be executed by hardware and/or a modeling and simulation program that may be coupled with hardware. In an example, a module may be implemented using general-purpose or special-purpose processors, digital signal processors (DSPs), microprocessors, microcontrollers, application-specific integrated circuits (ASICs), programmable logic devices (PLDs) and/or alike. The hardware may be programmed using machine language, assembly language, high-level language (e.g., Python, FORTRAN, C, C++ or the like) and/or alike. In an example, the function of a module may be achieved by using a combination of the mentioned implementation methods.

CLAIMS

What is claimed is:

1. A method comprising:

receiving, by a wireless device, one or more messages comprising:

first configuration parameters for beam failure recovery; and

second configuration parameters for listen-before-talk (LBT) failure recovery;

initiating, based on the first configuration parameters and in response to detecting a beam failure on a primary cell, a first random access process on a first bandwidth part (BWP) of the primary cell for beam failure recovery;

triggering, based on the second configuration parameters, consistent LBT failure for the primary cell;

stopping the first random access process, for the beam failure recovery, based on the triggering the consistent LBT failure;

switching from the first BWP of the primary cell to a second BWP of the primary cell as an active BWP of the primary cell; and

initiating a second random access process on the second BWP of the primary cell.

2. The method of claim 1, wherein the second random access process is for consistent LBT failure recovery.

3. The method of claim 2, further comprising initiating a third random access process, for the beam failure recovery, after the second random access process is successfully completed.

4. The method of claim 2, wherein the second random access process comprises transmitting a transport block comprising an LBT failure medium access control (MAC) control element (CE).

5. The method of claim 4, wherein:

the transmitting the transport block is based on a logical channel prioritization procedure; and

a first priority associated with the LBT failure MAC CE is higher than a second priority associated with data from any logical channel except uplink common control channel (UL-CCCH) logical channel.

6. The method of claim 1, wherein the second random access process is for the beam failure recovery.

7. The method of claim 6, further comprising initiating a third random access process for consistent LBT failure recovery after the second random access process is successfully completed.

8. The method of claim 6, wherein the second random access process comprises transmitting a transport block comprising a beam failure recovery medium access control (MAC) control element (CE).

9. The method of claim 8, wherein:

the transmitting the transport block is based on a logical channel prioritization procedure; and

a first priority associated with the beam failure recovery MAC CE is higher than a second priority associated with data from any logical channel except uplink common control channel (UL-CCCH) logical channel.

10. The method of claim 1, wherein:

the first configuration parameters, for beam failure recovery, comprise first random access parameters;

the one or more messages further comprise second random access parameters;

the first random access process, for the beam failure recovery, is based on the first random access parameters; and

the second random access process is for consistent LBT failure recovery and is based on the second random access parameters.

11. The method of claim 10, wherein the first random access parameters indicate random access resources for a beam failure recovery random access process.

12. The method of claim 10, wherein the first random access parameters indicate:

a random access response window for beam failure recovery;

a first number of preamble transmissions before declaring a random access failure for beam failure recovery;

a power ramping step for a beam failure recovery random access process; and

a configuration index for beam failure recovery.

13. The method of claim 1, wherein the first configuration parameters for beam failure recovery comprise an identifier of a search space for monitoring a control channel in a beam failure recovery random access process.

14. The method of claim 1, wherein:

the first configuration parameters comprise a first parameter indicating a first number of beam failure instances that triggers beam failure recovery; and

the detecting the beam failure is based on a beam failure instance indication counter reaching the first number.

15. The method of claim 14, wherein the detecting the beam failure comprises incrementing the beam failure instance indication counter by one based on a beam failure indication.

16. The method of claim 14, wherein the detecting the beam failure comprises setting the beam failure instance indication counter to zero based on a beam failure detection timer expiring.

17. The method of claim 1, wherein:

the second configuration parameters comprise a first parameter indicating a first number of LBT failure instances that triggers LBT failure recovery; and

the triggering the consistent LBT failure is based on an LBT failure indication counter reaching the first number.

18. The method of claim 17, wherein the triggering the consistent LBT failure comprises incrementing the LBT failure indication counter by one based on an LBT failure indication.

19. The method of claim 17, wherein the triggering the consistent LBT failure comprises setting the LBT failure indication counter to zero based on an LBT failure detection timer expiring.

20. The method of claim 1, wherein:

the second BWP of the primary cell is configured with random access occasions; and

the switching from the first BWP of the primary cell to a second BWP of the primary cell is based on the second BWP of the primary cell being configured with the random access occasions.

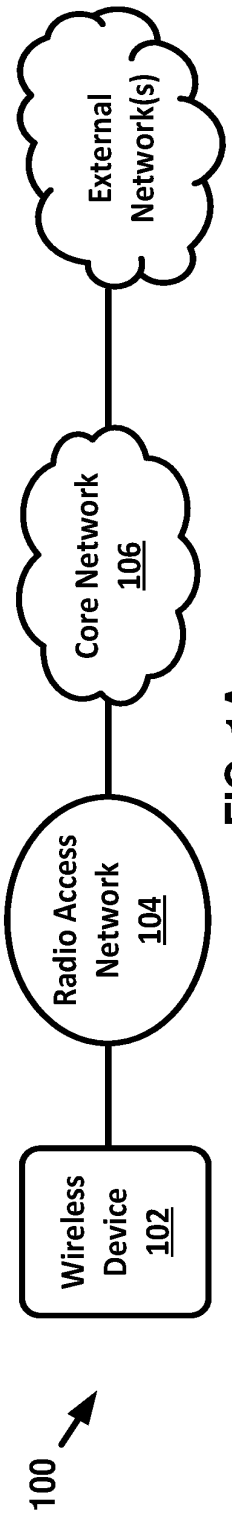
External Network(s)
Core Network 106
Radio Access Network 104
Wireless Device 102
100

FIG. 1A

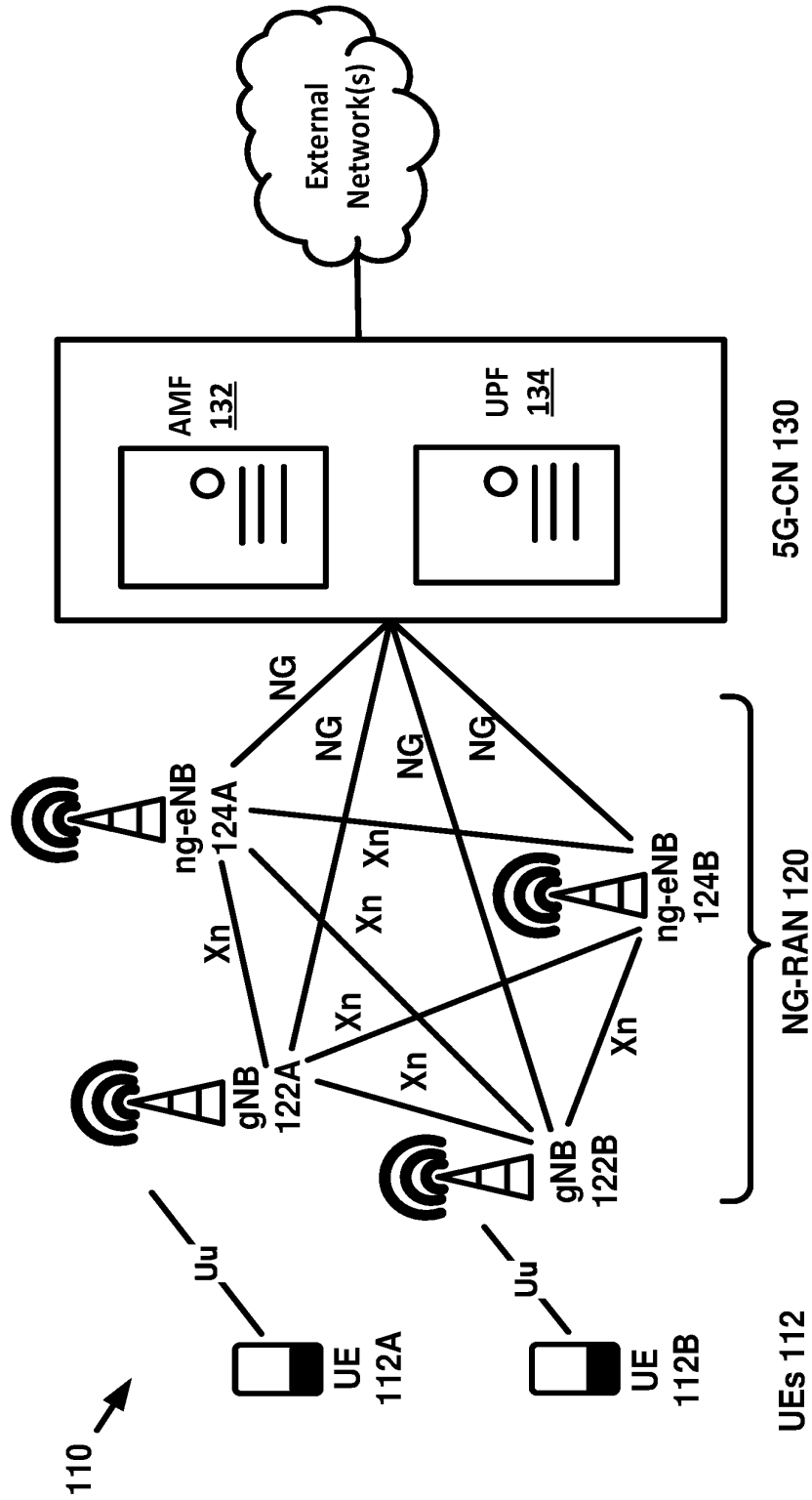
External Network(s)
AMF 132
UPF 134
5G-CN 130
NG
NG
NG
NG
ng-eNB 124A
ng-eNB 124B
Xn
Xn
Xn
Xn
Xn
Xn
gNB 122A
gNB 122B
NG-RAN 120
Uu
Uu
UE 112A
UE 112B
UEs 112
110

FIG. 1B

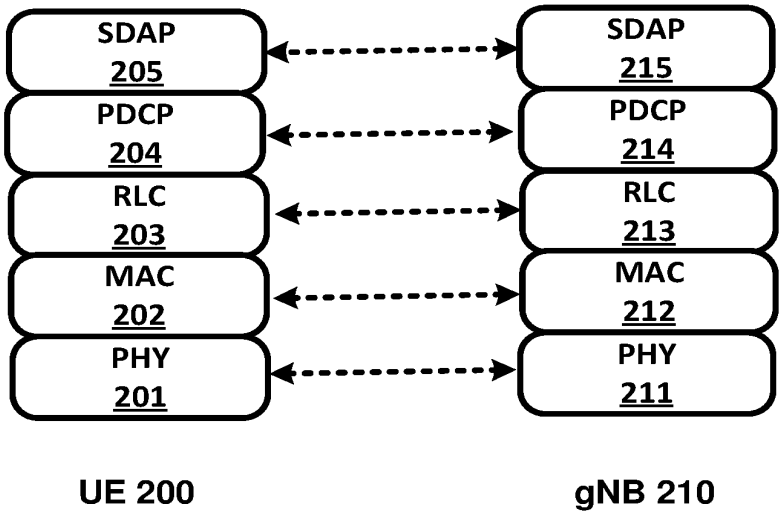
SDAP
205
PDCP
204
RLC
203
MAC
202
PHY
201
SDAP
215
PDCP
214
RLC
213
MAC
212
PHY
211
UE 200
gNB 210

FIG. 2A

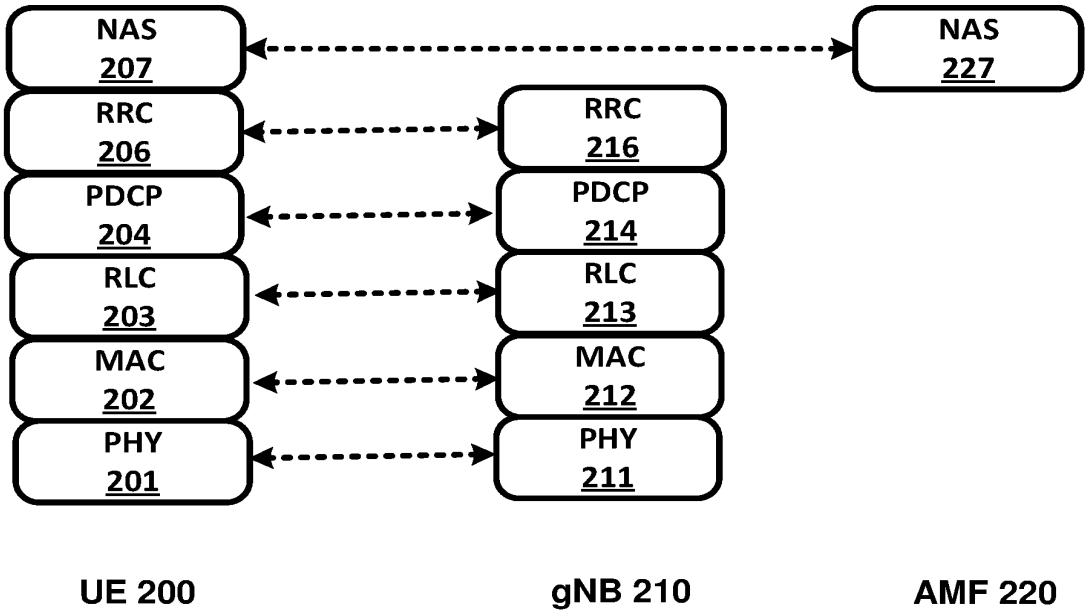
NAS
207
RRC
206
PDCP
204
RLC
203
MAC
202
PHY
201
RRC
216
PDCP
214
RLC
213
MAC
212
PHY
211
NAS
227
UE 200
gNB 210
AMF 220

FIG. 2B

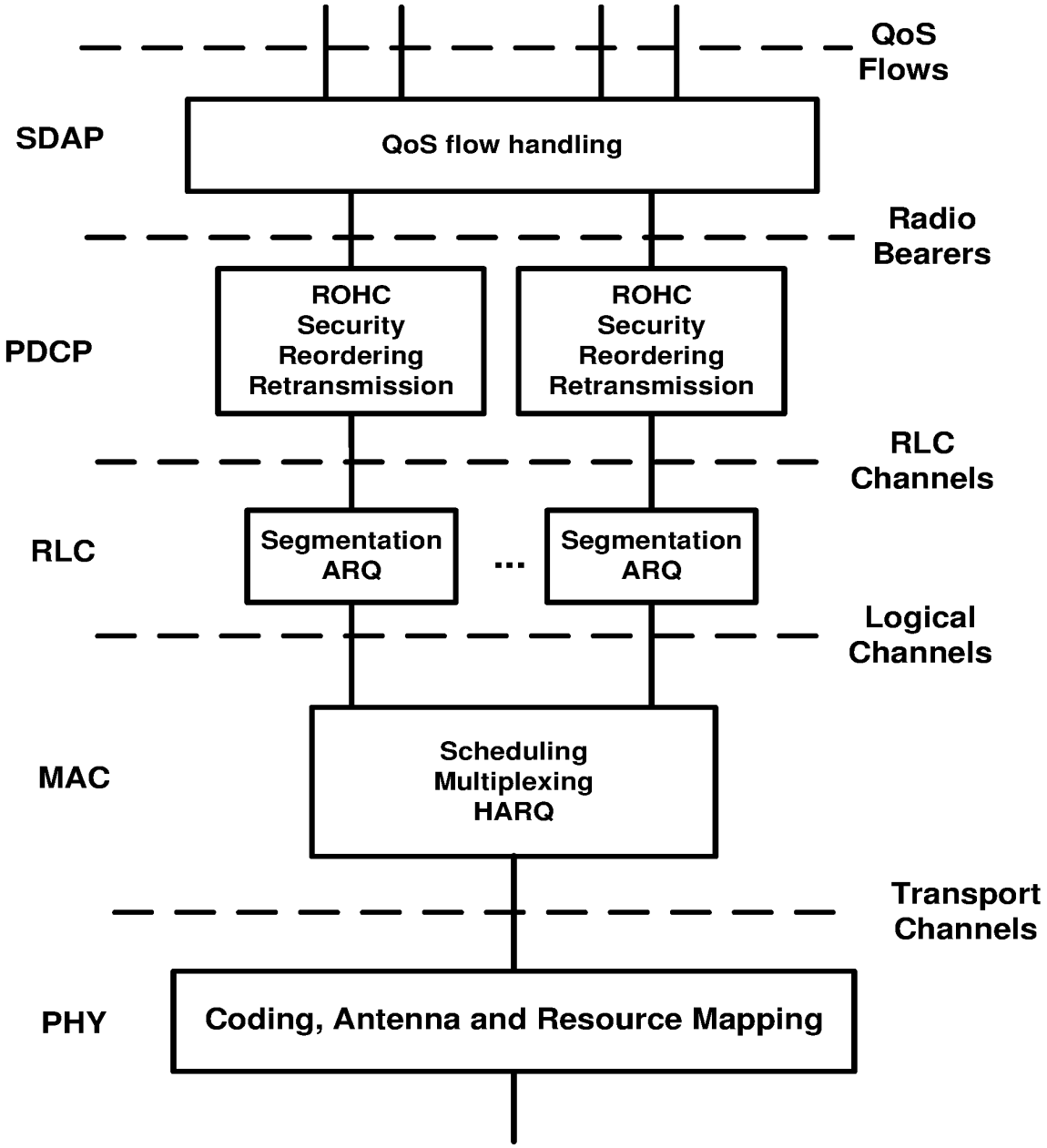
QoS Flows
SDAP
QoS flow handling
Radio Bearers
PDCP
ROHC
Security
Reordering
Retransmission
ROHC
Security
Reordering
Retransmission
RLC Channels
RLC
Segmentation
ARQ
...
Segmentation
ARQ
Logical Channels
MAC
Scheduling
Multiplexing
HARQ
Transport Channels
PHY
Coding, Antenna and Resource Mapping

FIG. 3

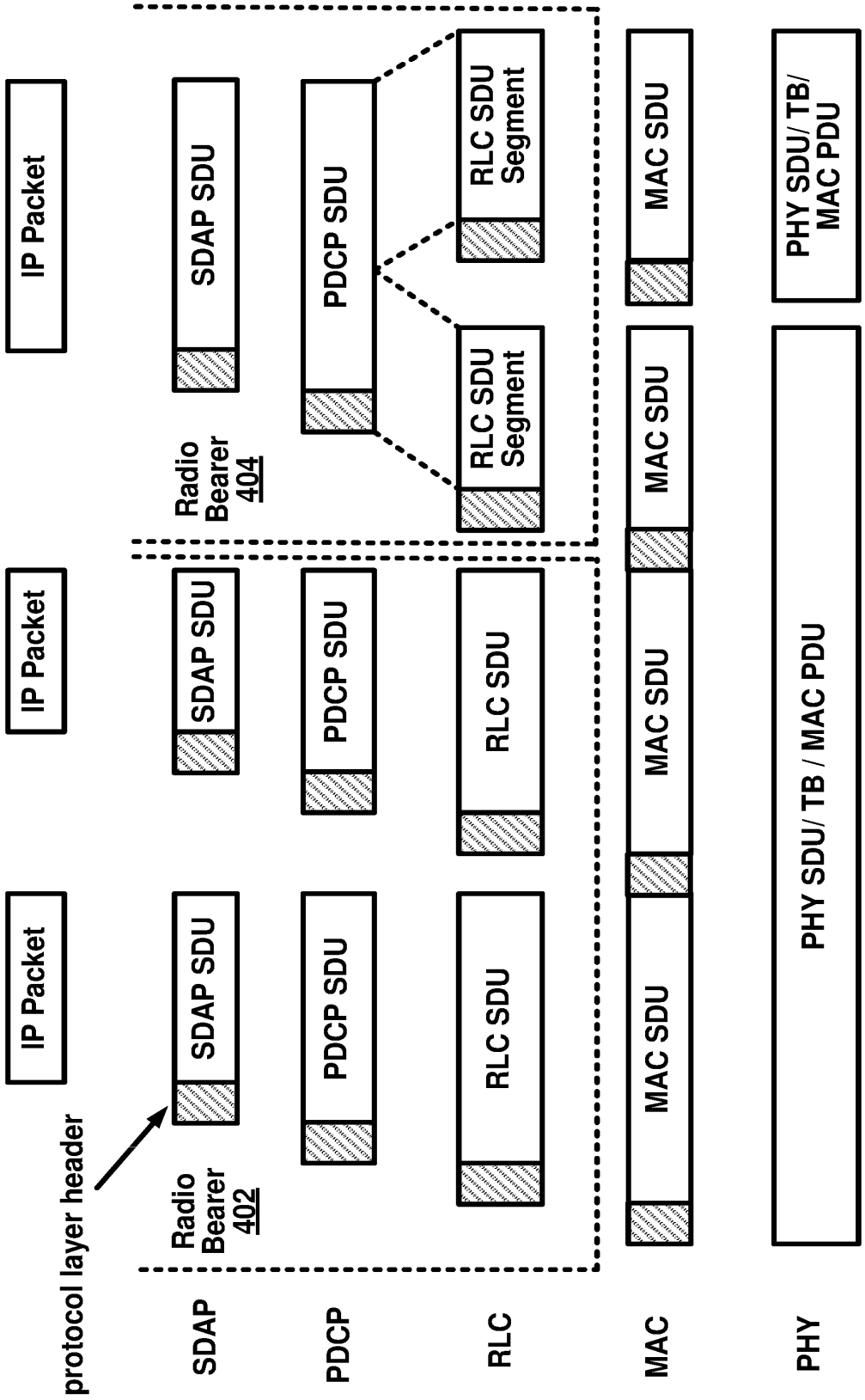
IP Packet
IP Packet
IP Packet
SDAP SDU
SDAP SDU
SDAP SDU
PDCP SDU
PDCP SDU
PDCP SDU
RLC SDU Segment
RLC SDU Segment
RLC SDU
RLC SDU
MAC SDU
MAC SDU
MAC SDU
MAC SDU
PHY SDU/ TB/ MAC PDU
PHY SDU/ TB / MAC PDU
Radio Bearer 404
Radio Bearer 402
protocol layer header
SDAP
PDCP
RLC
MAC
PHY

FIG. 4

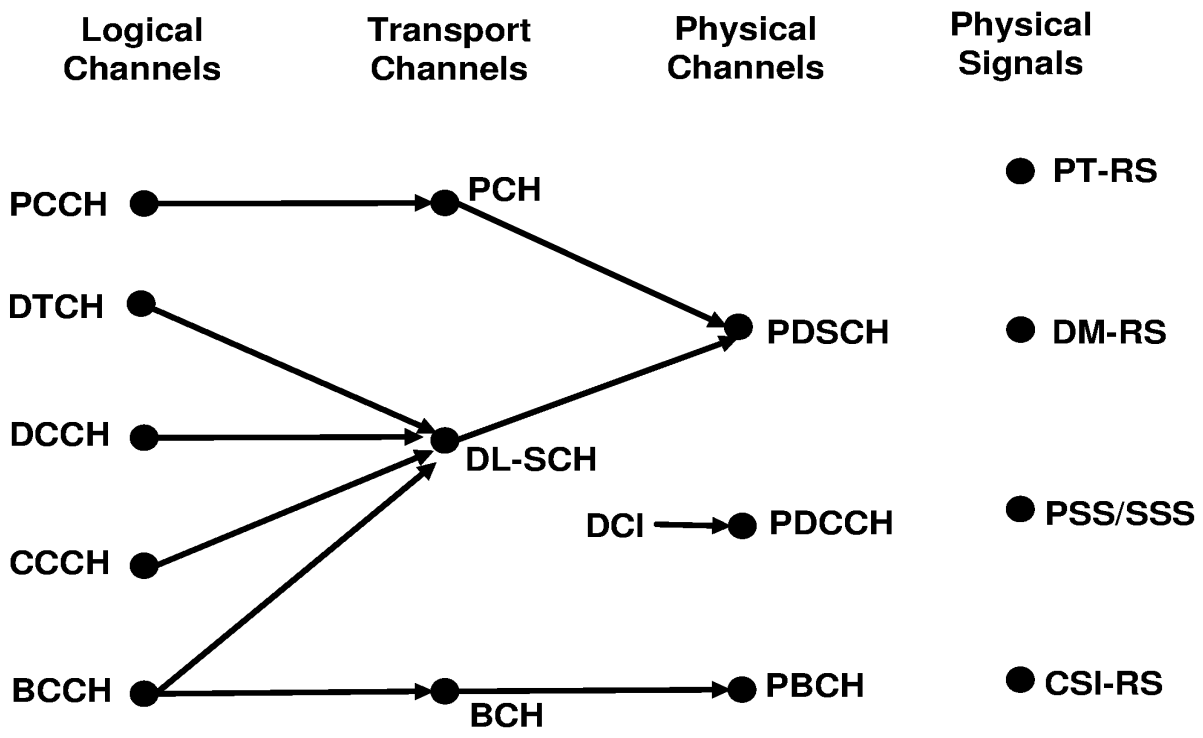
Logical Channels
Transport Channels
Physical Channels
Physical Signals
PCCH
DTCH
DCCH
CCCH
BCCH
PCH
DL-SCH
BCH
PDSCH
DCI
PDCCH
PBCH
PT-RS
DM-RS
PSS/SSS
CSI-RS

FIG. 5A

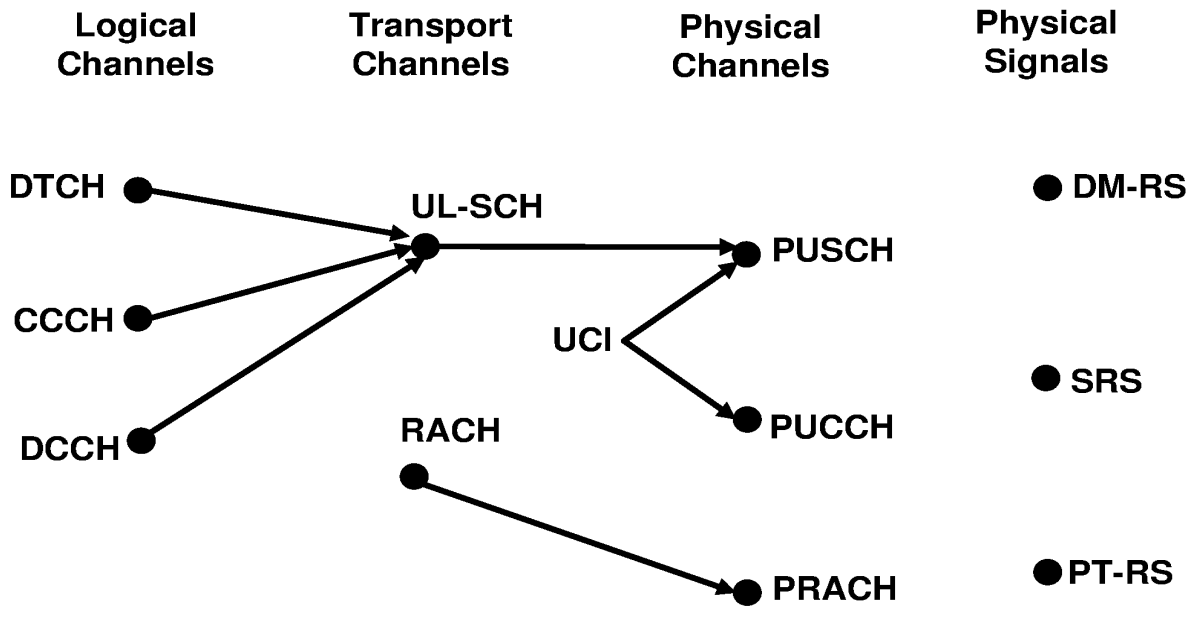
Logical Channels
Transport Channels
Physical Channels
Physical Signals
DTCH
CCCH
DCCH
UL-SCH
RACH
PUSCH
UCI
PUCCH
PRACH
DM-RS
SRS
PT-RS

FIG. 5B

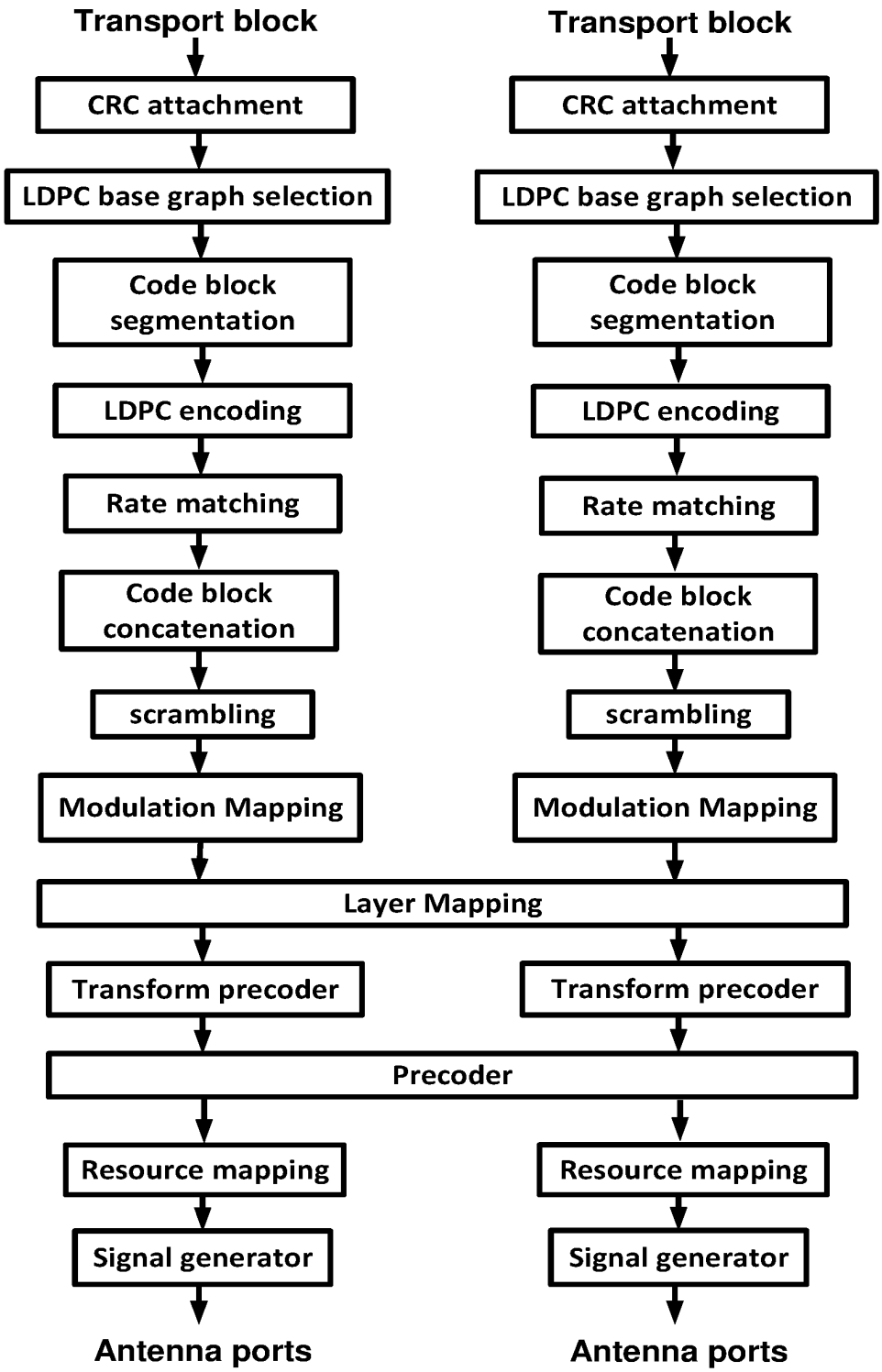
Transport block
CRC attachment
LDPC base graph selection
Code block segmentation
LDPC encoding
Rate matching
Code block concatenation
scrambling
Modulation Mapping
Transport block
CRC attachment
LDPC base graph selection
Code block segmentation
LDPC encoding
Rate matching
Code block concatenation
scrambling
Modulation Mapping
Layer Mapping
Transform precoder
Transform precoder
Precoder
Resource mapping
Signal generator
Antenna ports
Resource mapping
Signal generator
Antenna ports

FIG. 6

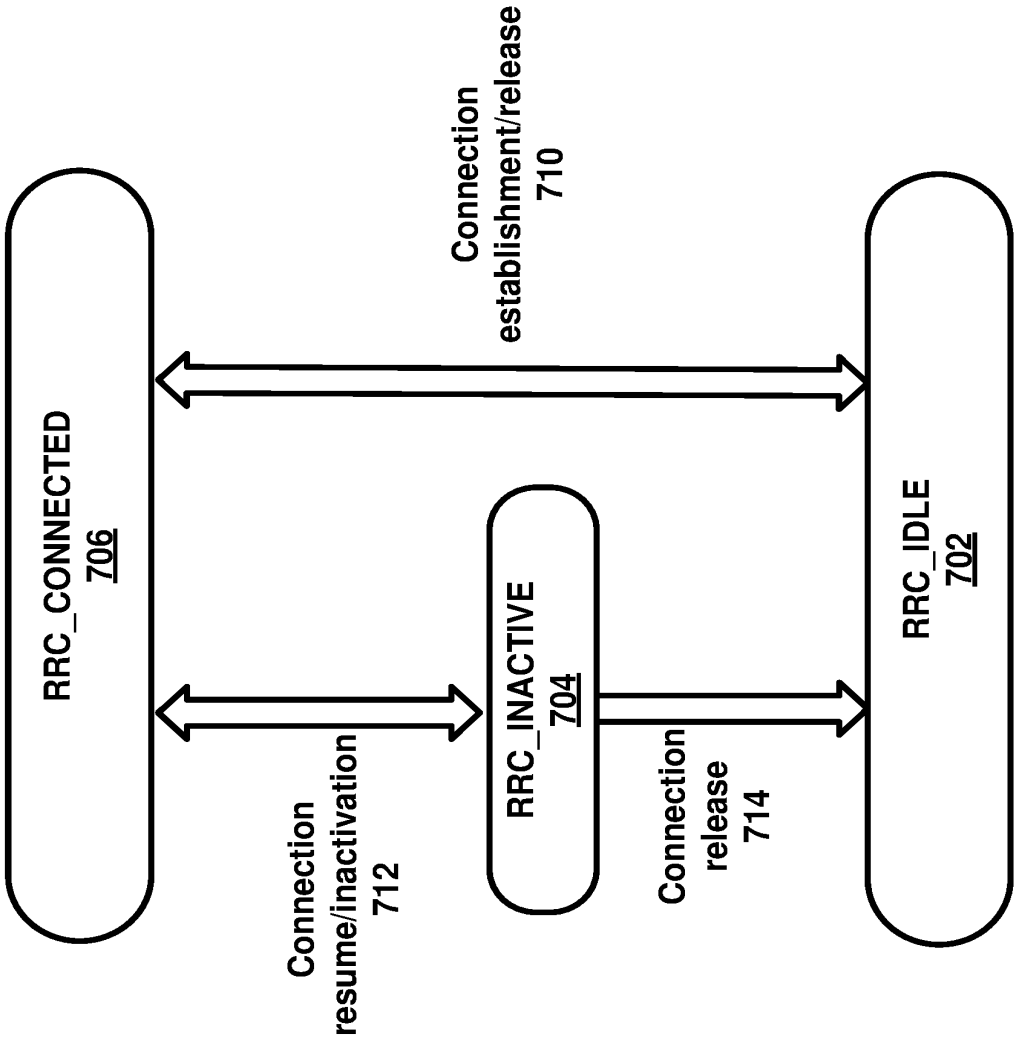
RRC_CONNECTED
706
Connection
establishment/release
710
RRC_INACTIVE
704
RRC_IDLE
702
Connection
resume/inactivation
712
Connection
release
714

FIG. 7

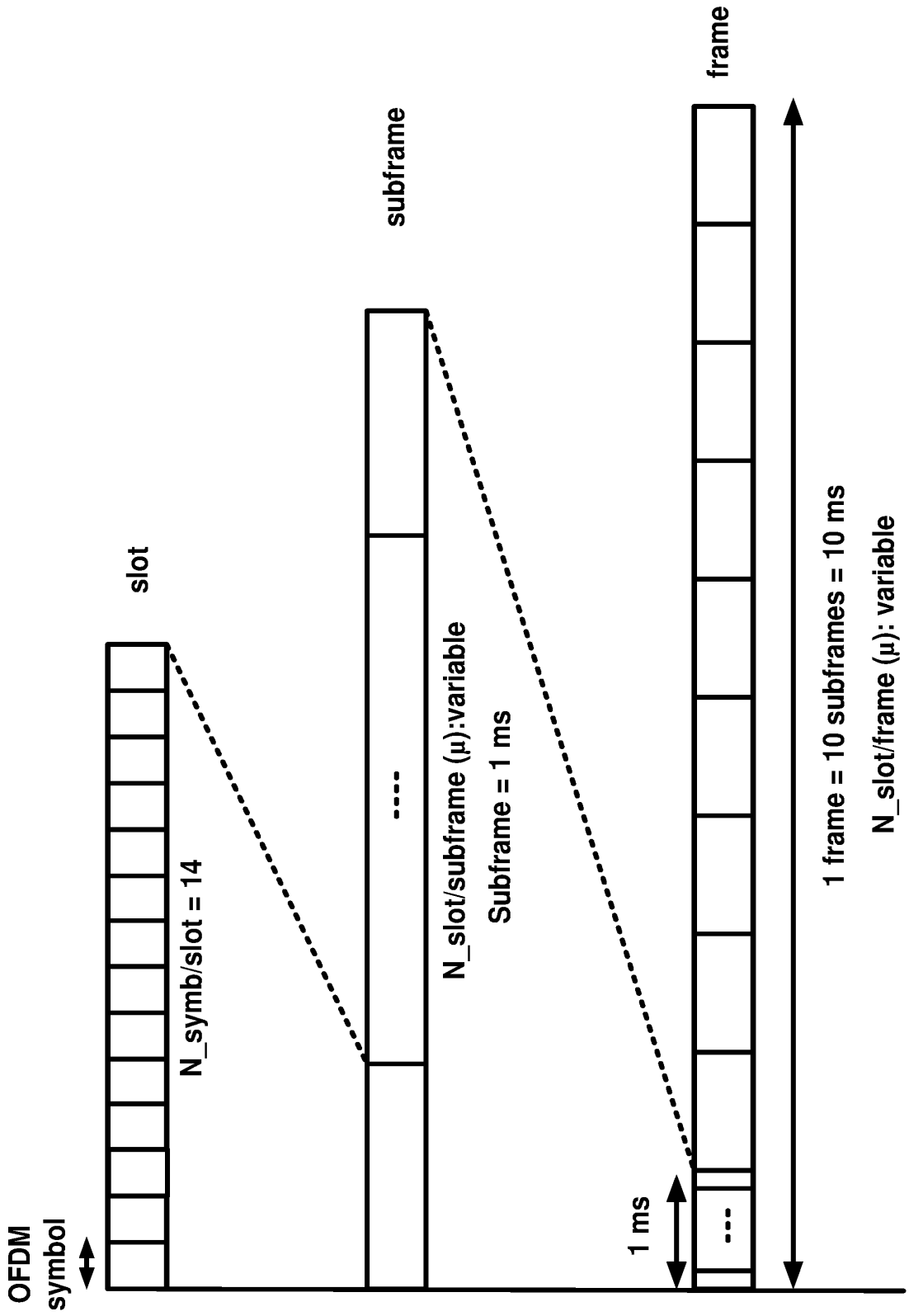
OFDM symbol
slot
N_symb/slot = 14
subframe
N_slot/subframe (μ):variable
Subframe = 1 ms
1 ms
frame
1 frame = 10 subframes = 10 ms
N_slot/frame (μ): variable

FIG. 8

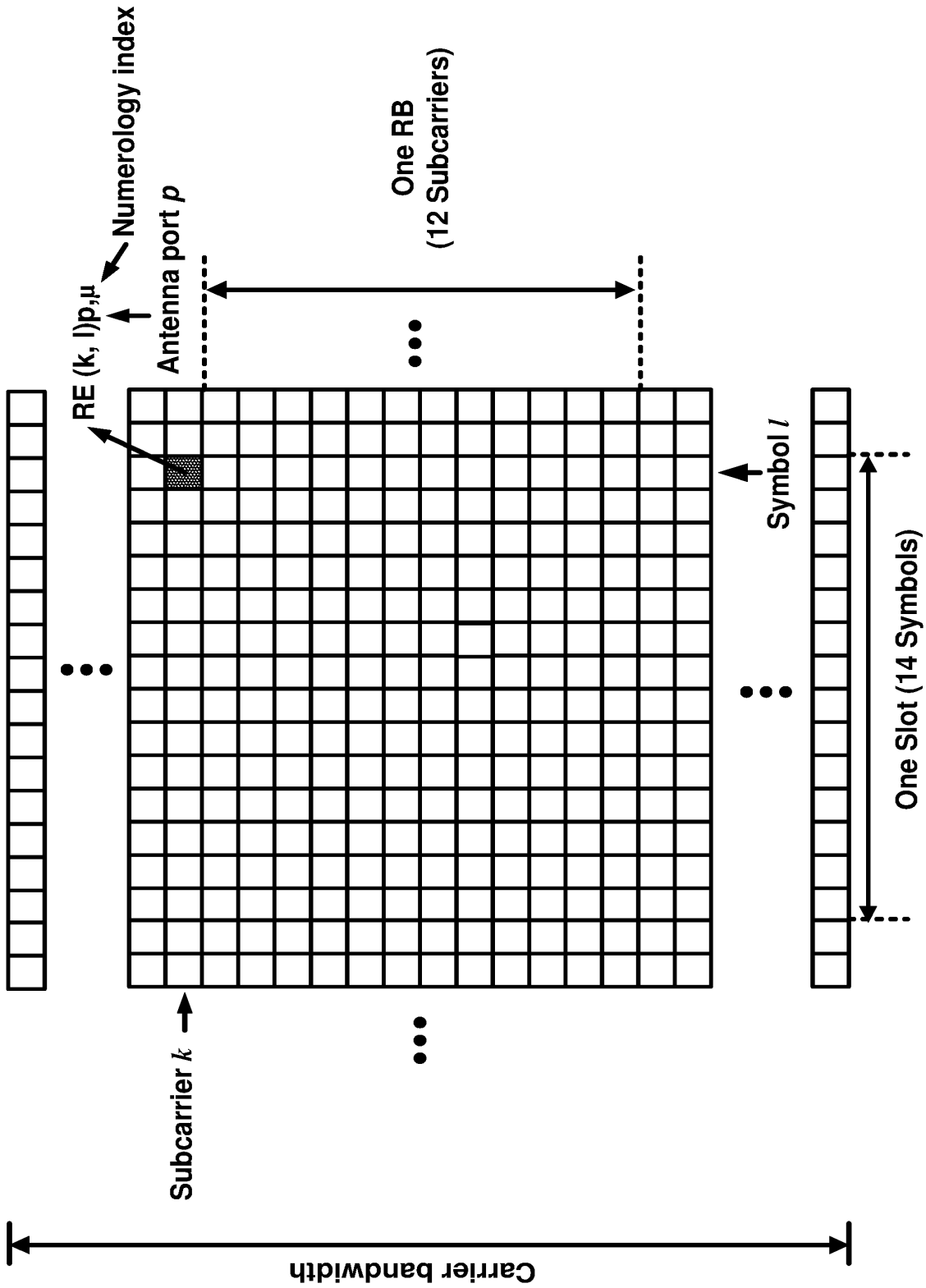
Numerology index
RE (k, l)p,μ
Antenna port p
One RB
(12 Subcarriers)
Symbol l
One Slot (14 Symbols)
Subcarrier k
Carrier bandwidth

FIG. 9

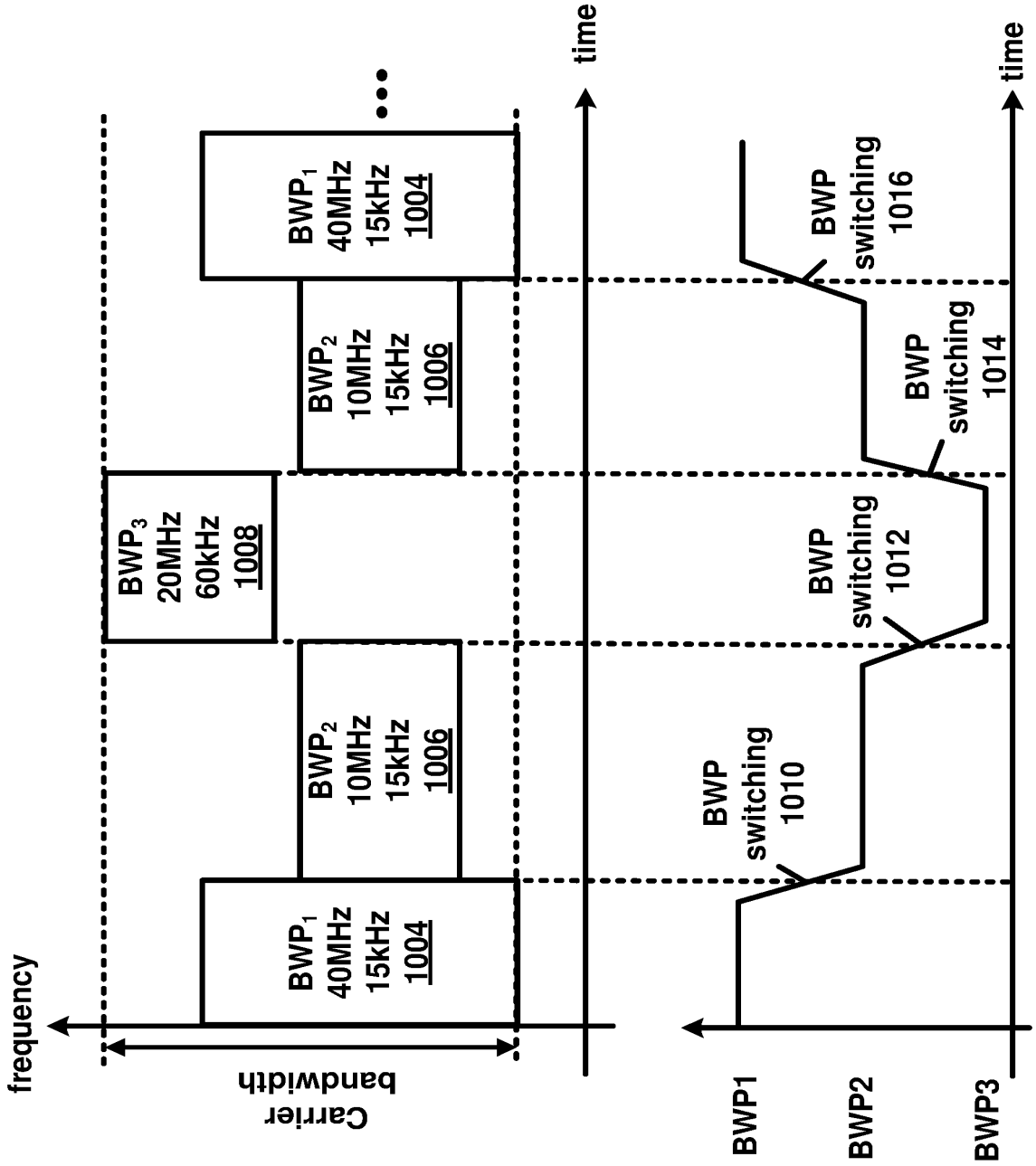
frequency
Carrier bandwidth
BWP1 40MHz 15kHz 1004
BWP2 10MHz 15kHz 1006
BWP3 20MHz 60kHz 1008
BWP2 10MHz 15kHz 1006
BWP1 40MHz 15kHz 1004
time
BWP1
BWP2
BWP3
BWP switching 1010
BWP switching 1012
BWP switching 1014
BWP switching 1016
time

FIG. 10

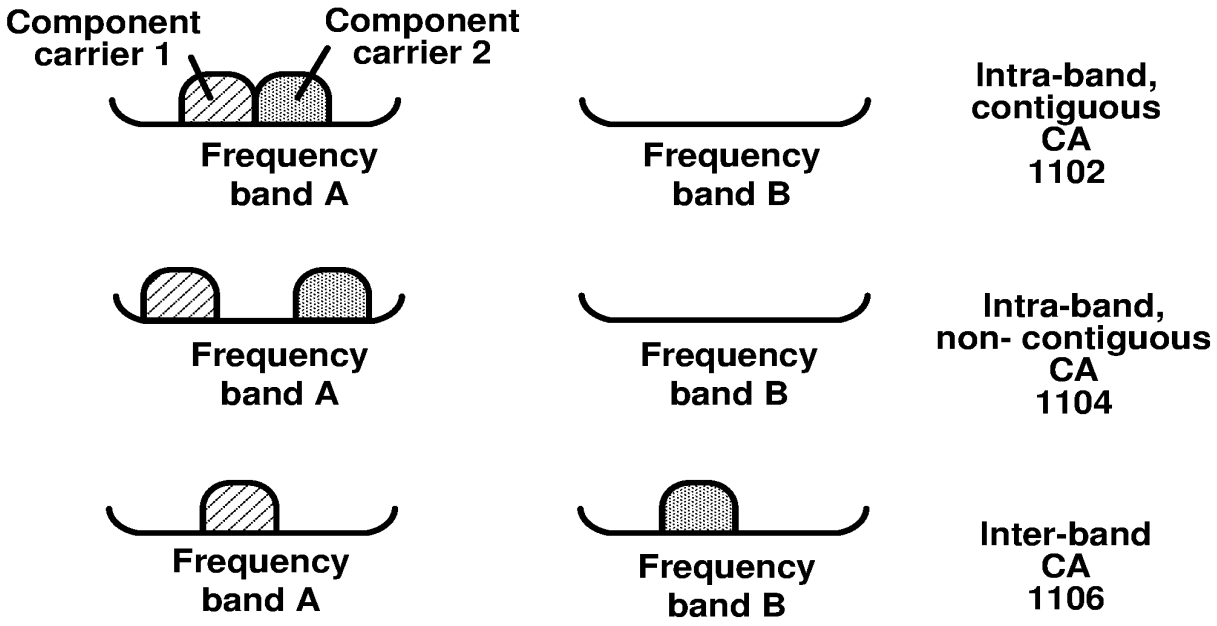

FIG. 11A

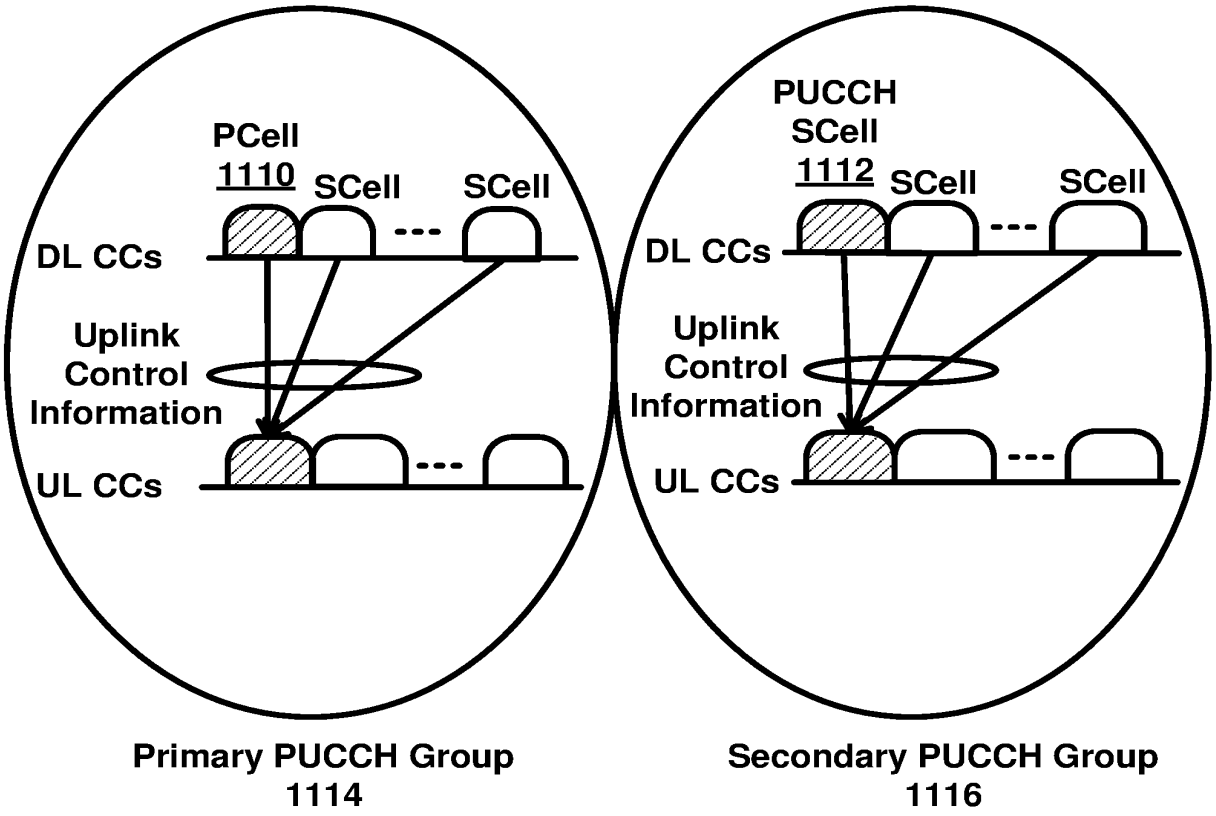

FIG. 11B

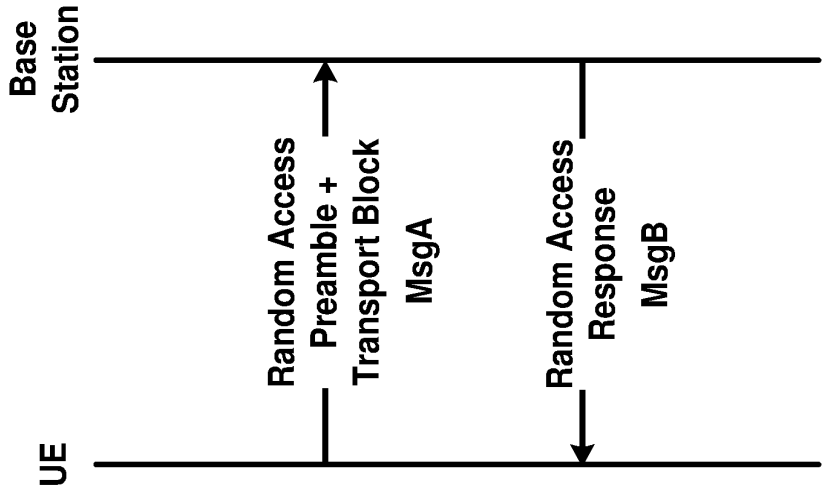

FIG. 12C

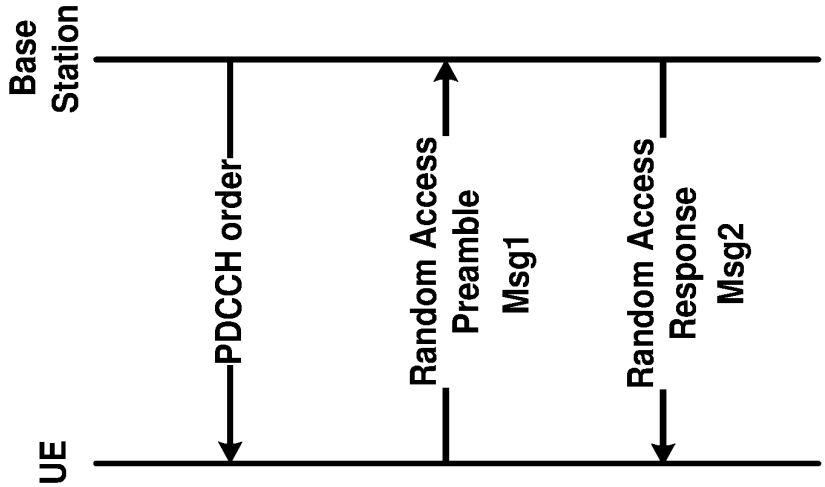

FIG. 12B

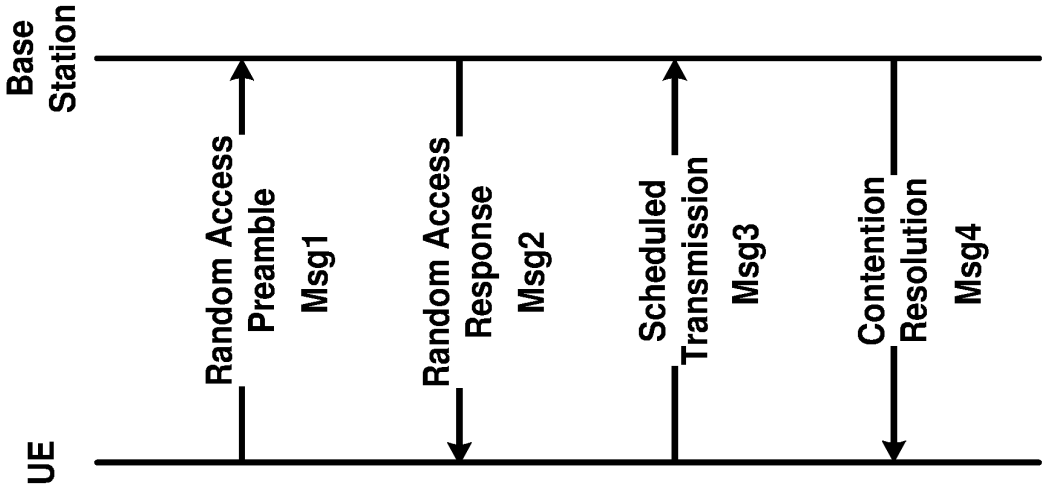

FIG. 12A

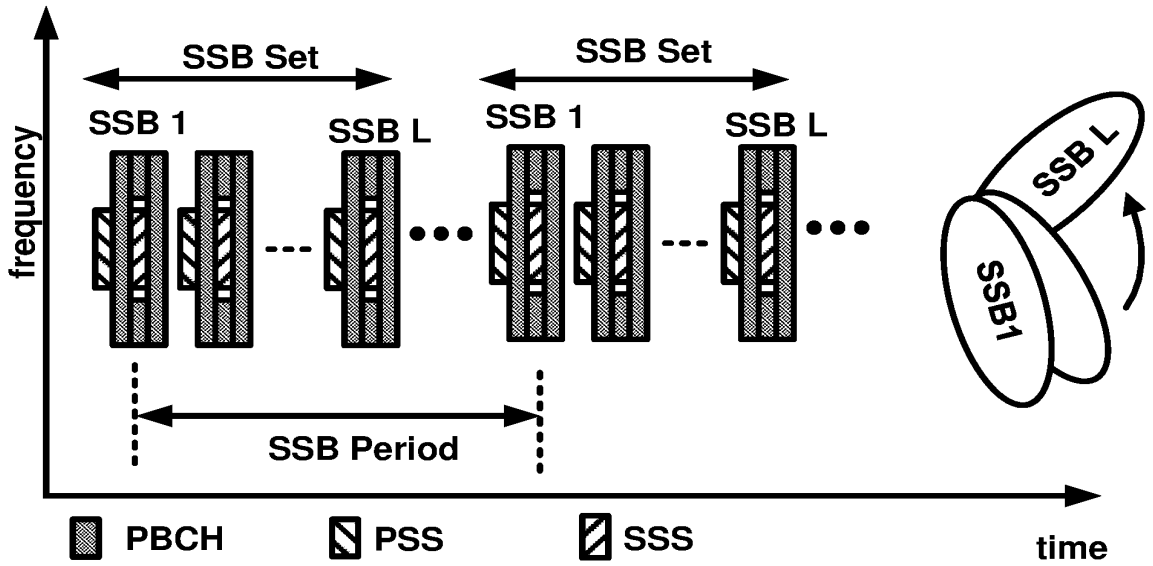

FIG. 13A

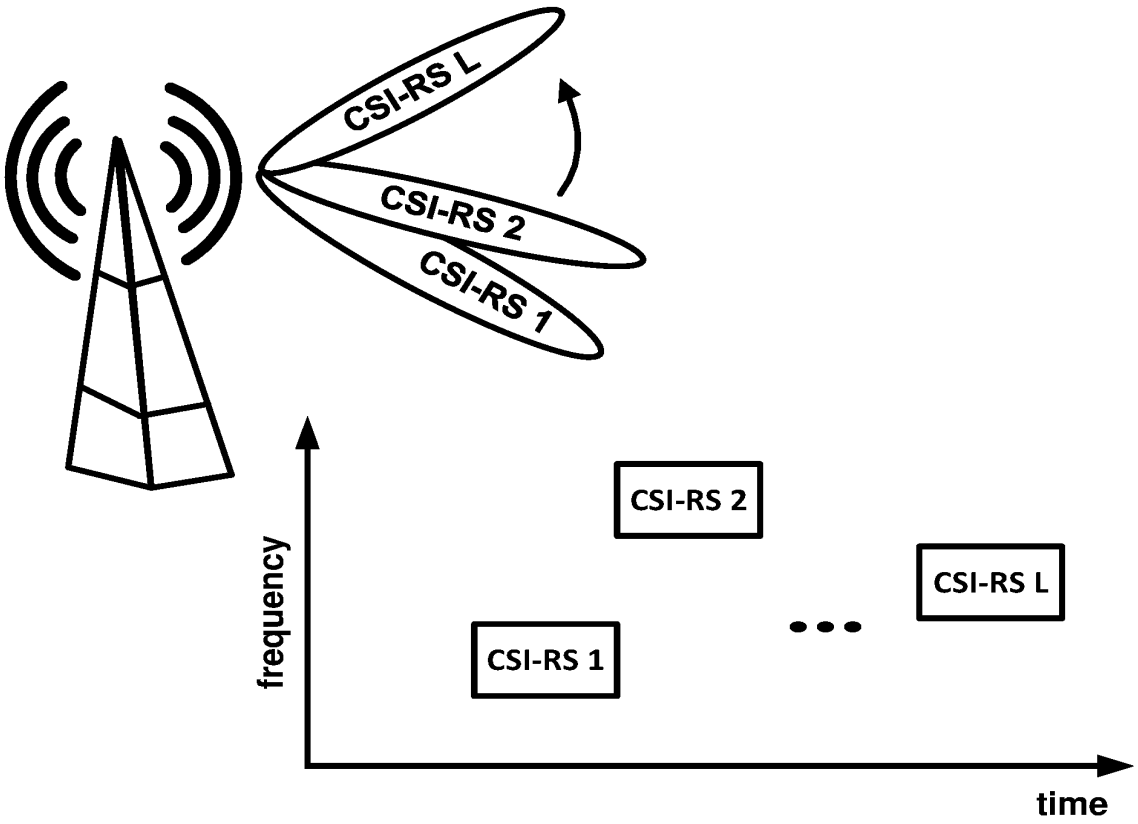

FIG. 13B

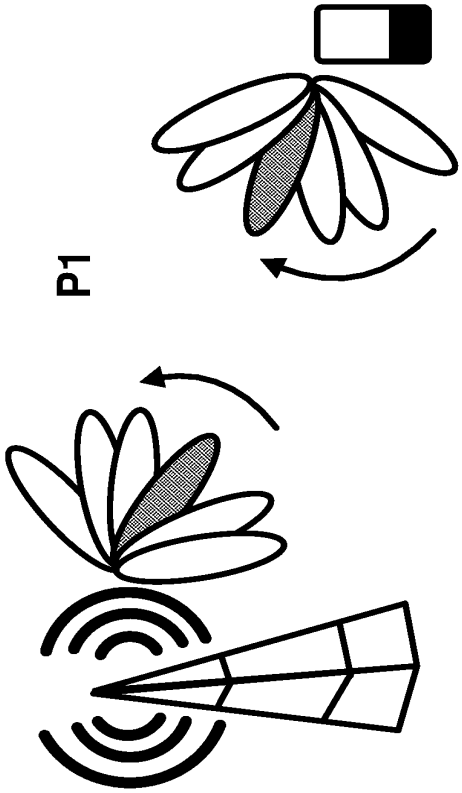

FIG. 14A

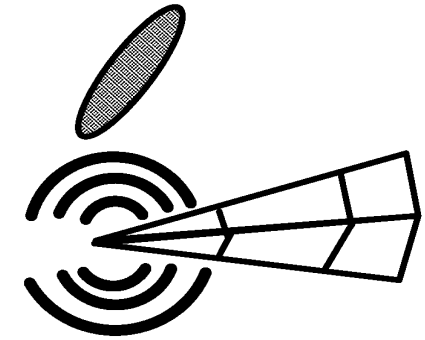

FIG. 14B

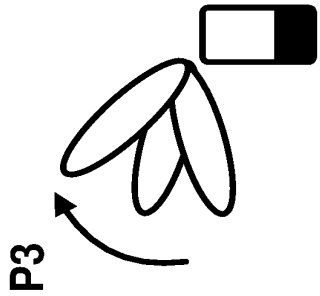

FIG. 14C

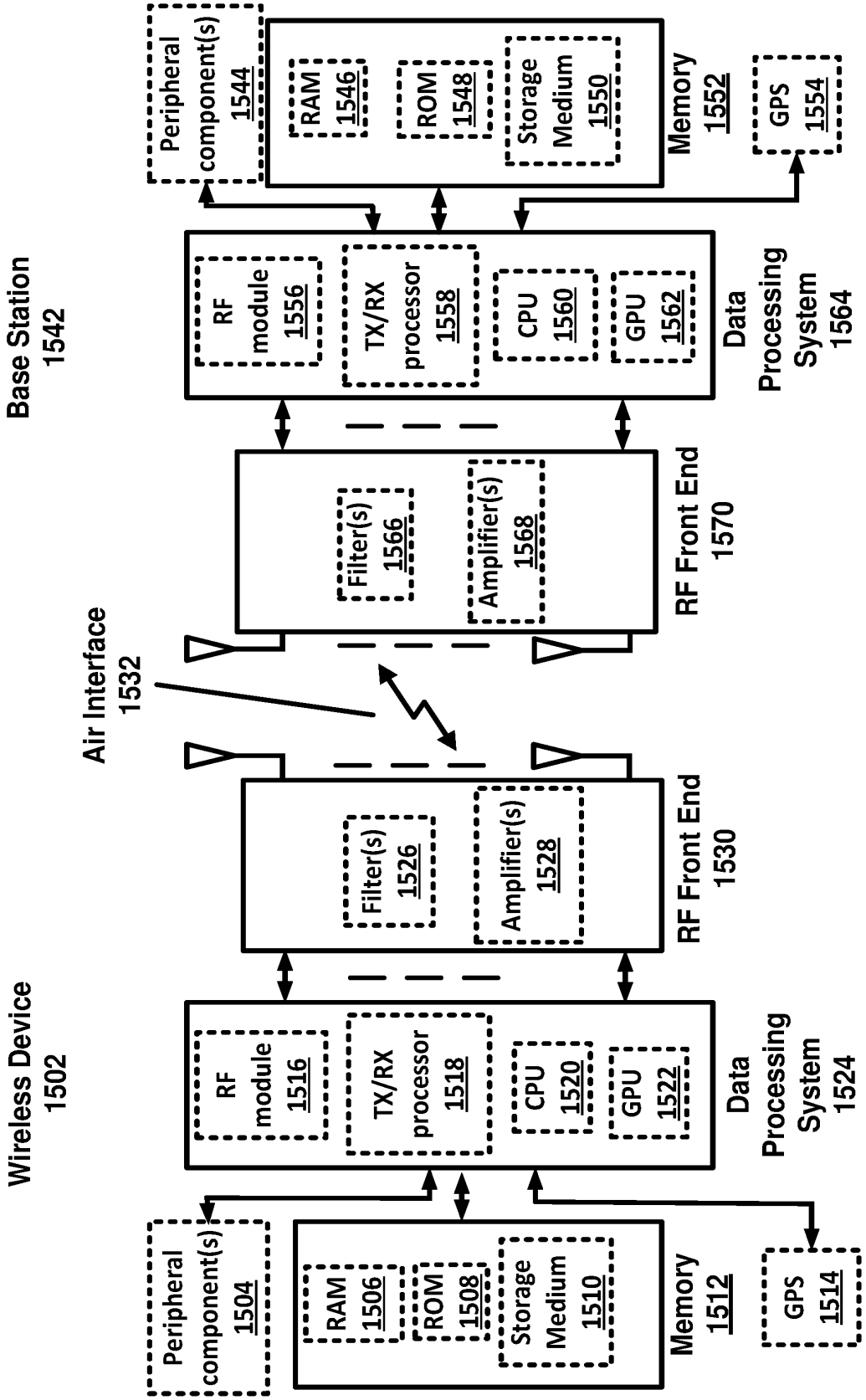
Wireless Device
1502
Peripheral component(s)
1504
RAM
1506
ROM
1508
Storage Medium
1510
Memory
1512
GPS
1514
RF module
1516
TX/RX processor
1518
CPU
1520
GPU
1522
Data Processing System
1524
Filter(s)
1526
Amplifier(s)
1528
RF Front End
1530
Air Interface
1532
Filter(s)
1566
Amplifier(s)
1568
RF Front End
1570
Base Station
1542
RF module
1556
TX/RX processor
1558
CPU
1560
GPU
1562
Data Processing System
1564
Peripheral component(s)
1544
RAM
1546
ROM
1548
Storage Medium
1550
Memory
1552
GPS
1554

FIG. 15

Channel Access Priority Class (p)	m_p	$CW_{min,p}$	$CW_{max,p}$	$T_{ulm\,cot,p}$	allowed CW_p sizes
1	2	3	7	2 ms	{3,7}
2	2	7	15	4 ms	{7,15}
3	3	15	1023	6ms or 10 ms	{15,31,63,127,255,511,1023}
4	7	15	1023	6ms or 10 ms	{15,31,63,127,255,511,1023}

For $p = 3, 4$, $T_{ulm\,cot,p}$ =10ms if the higher layer parameter absenceOfAnyOtherTechnology-r14or absenceOfAnyOtherTechnology-r16 may be provided , otherwise, $T_{ulm\,cot,p}$ =6ms.

When $T_{ulm\,cot,p}$=6ms it may be increased to 8 ms by inserting one or more gaps. The minimum duration of a gap may be 100 µs. The maximum duration before including any such gap may be 6 ms.

FIG. 16

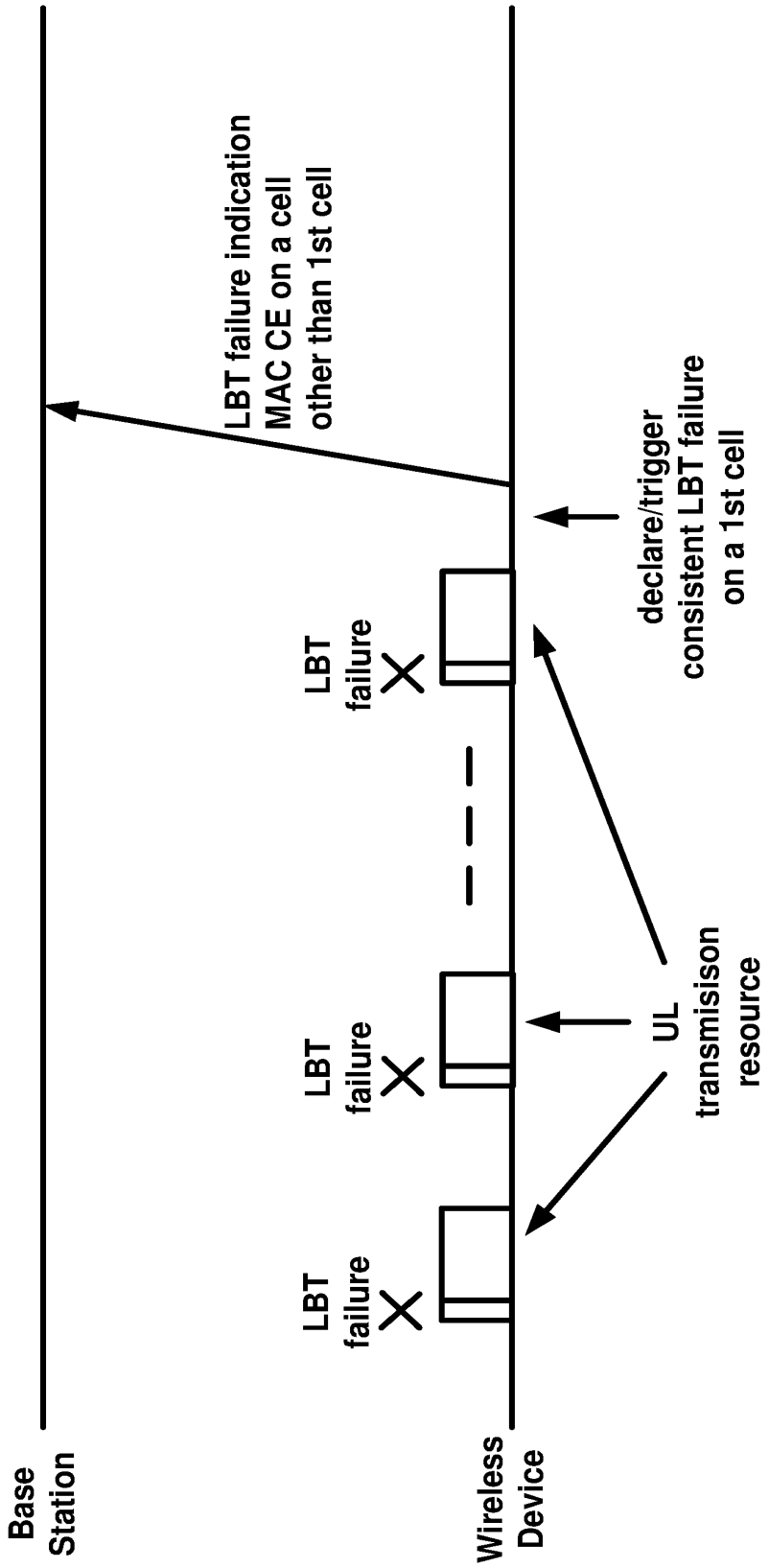
Base Station
Wireless Device
LBT failure
LBT failure
LBT failure
LBT failure indication MAC CE on a cell other than 1st cell
declare/trigger consistent LBT failure on a 1st cell
UL transmisison resource

FIG. 17

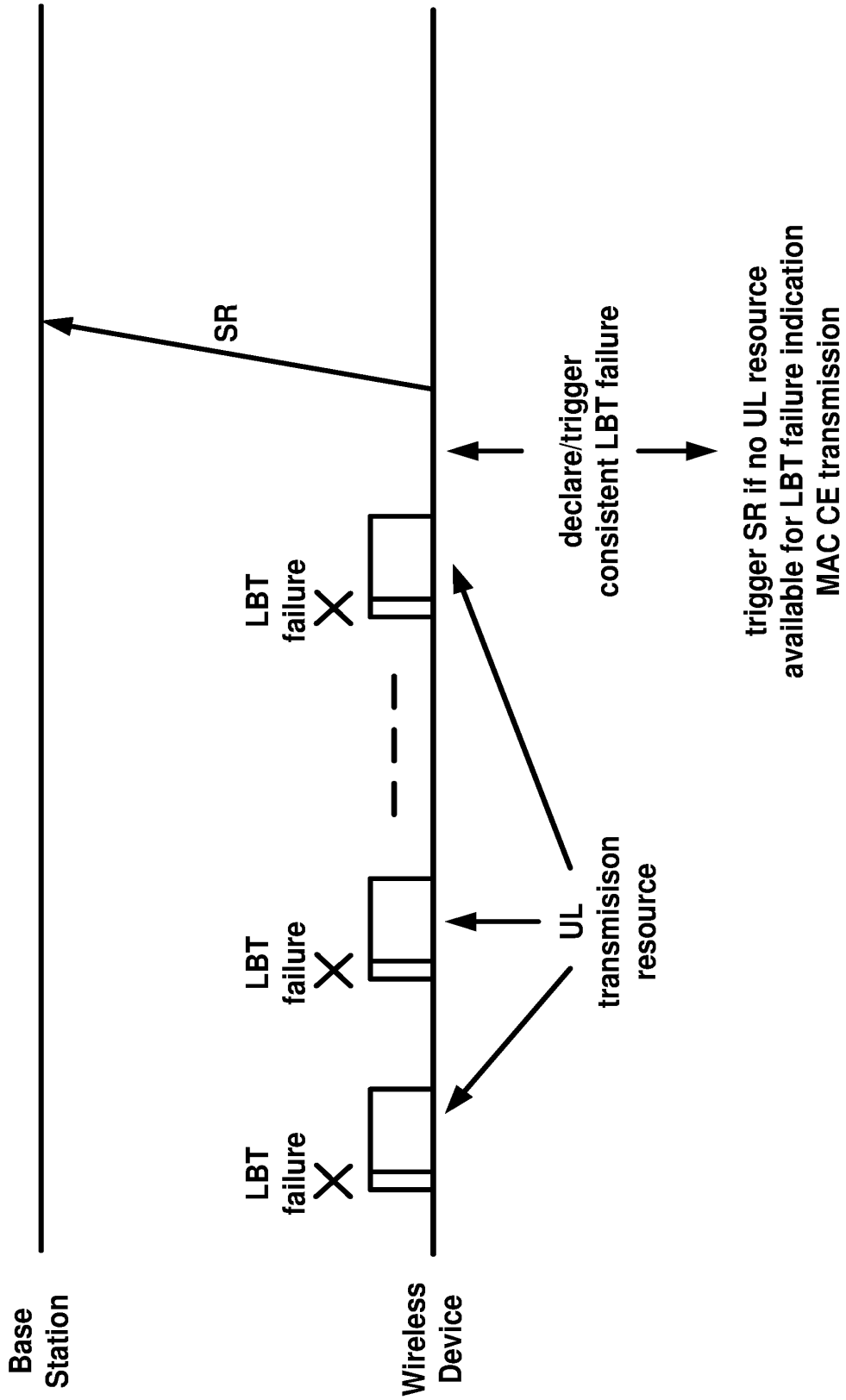
Base Station
Wireless Device
SR
LBT failure
LBT failure
LBT failure
UL transmisison resource
declare/trigger consistent LBT failure
trigger SR if no UL resource available for LBT failure indication MAC CE transmission

FIG. 18

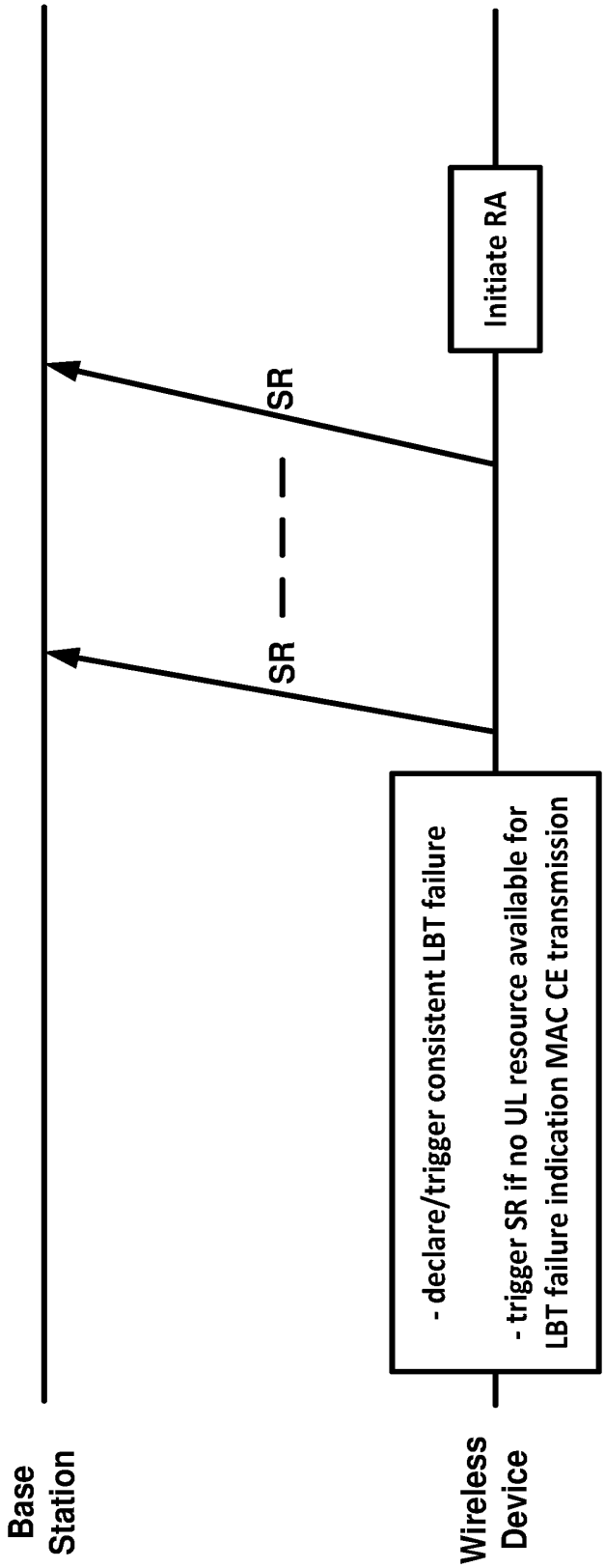
Base Station
Wireless Device
- declare/trigger consistent LBT failure
- trigger SR if no UL resource available for LBT failure indication MAC CE transmission
SR
SR
Initiate RA

FIG. 19

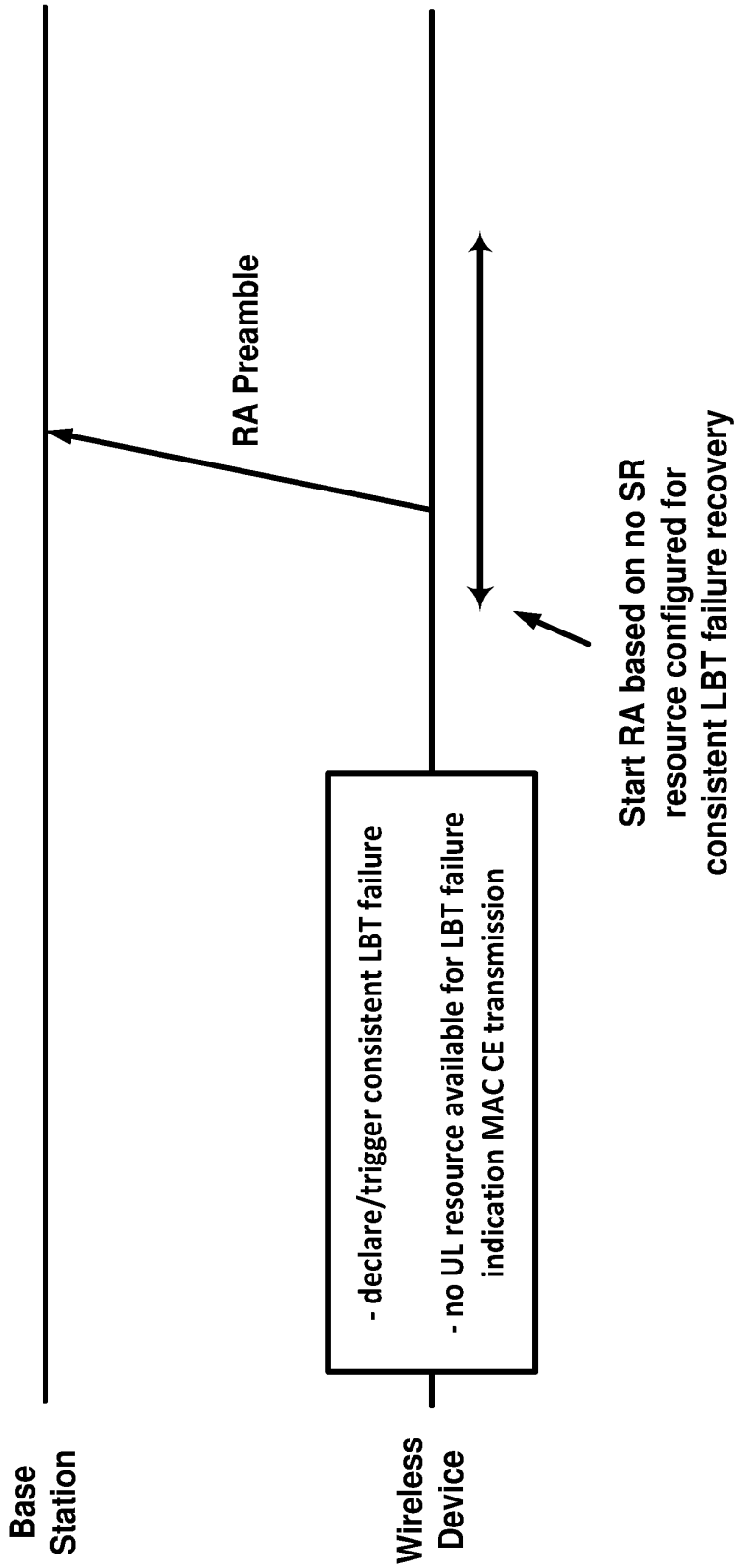
Base Station
Wireless Device
RA Preamble
- declare/trigger consistent LBT failure
- no UL resource available for LBT failure indication MAC CE transmission
Start RA based on no SR resource configured for consistent LBT failure recovery

FIG. 20

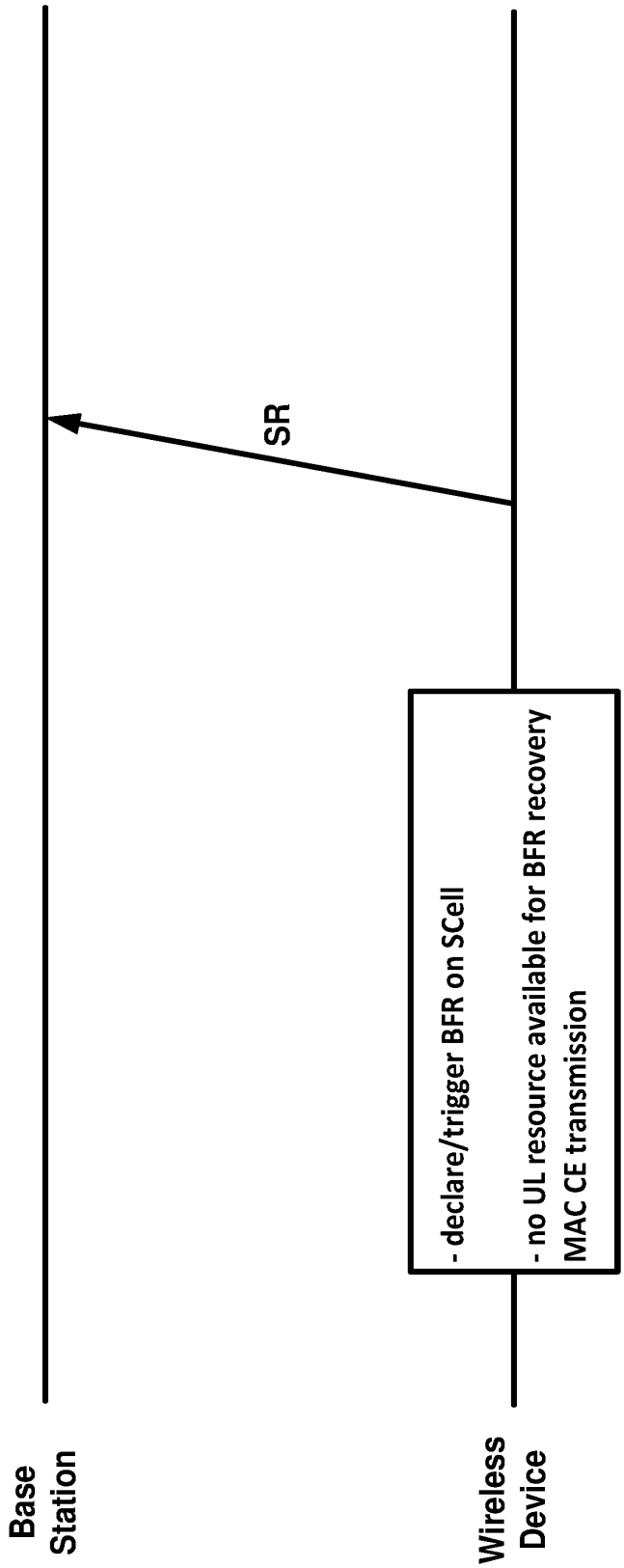
Base Station
Wireless Device
SR
- declare/trigger BFR on SCell
- no UL resource available for BFR recovery MAC CE transmission

FIG. 21

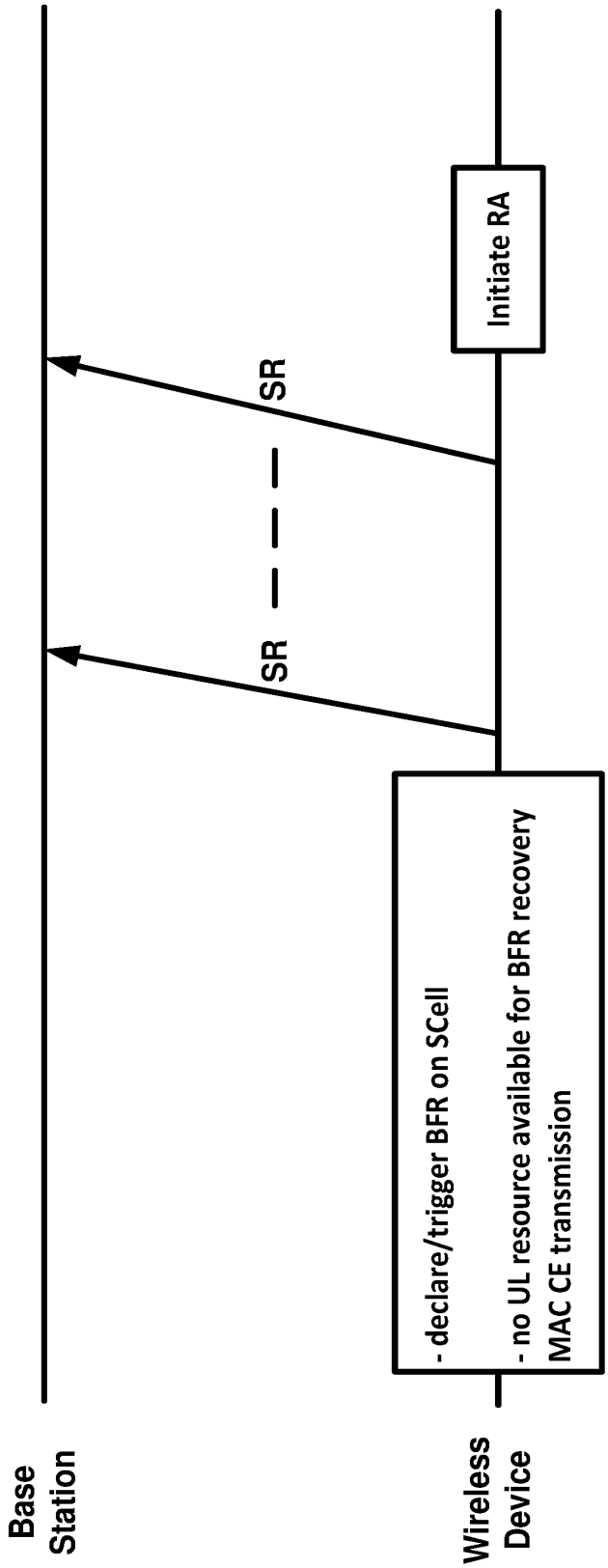
Base Station
Wireless Device
- declare/trigger BFR on SCell
- no UL resource available for BFR recovery
MAC CE transmission
SR
SR
Initiate RA

FIG. 22

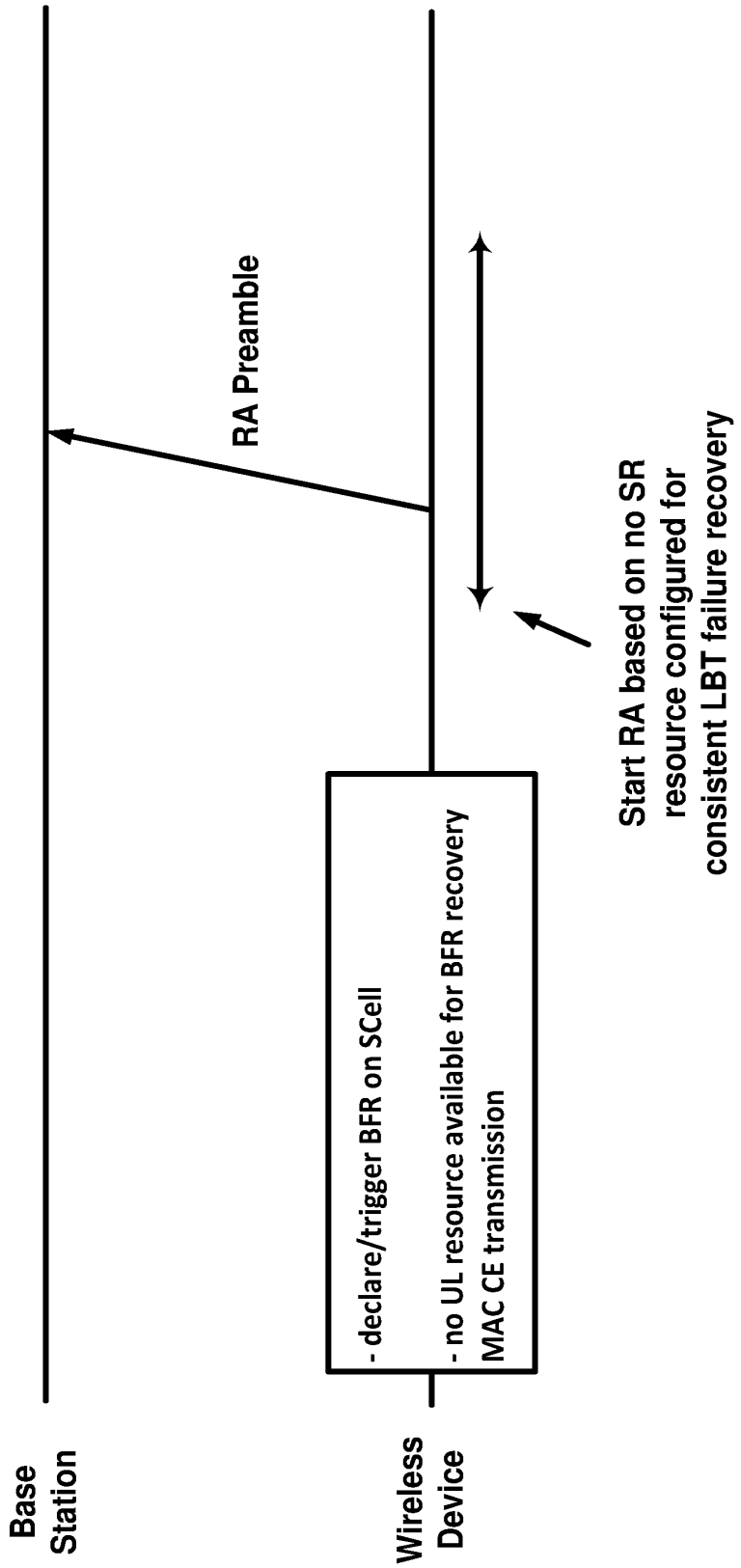
Base Station
Wireless Device
RA Preamble
- declare/trigger BFR on SCell
- no UL resource available for BFR recovery
MAC CE transmission
Start RA based on no SR resource configured for consistent LBT failure recovery

FIG. 23

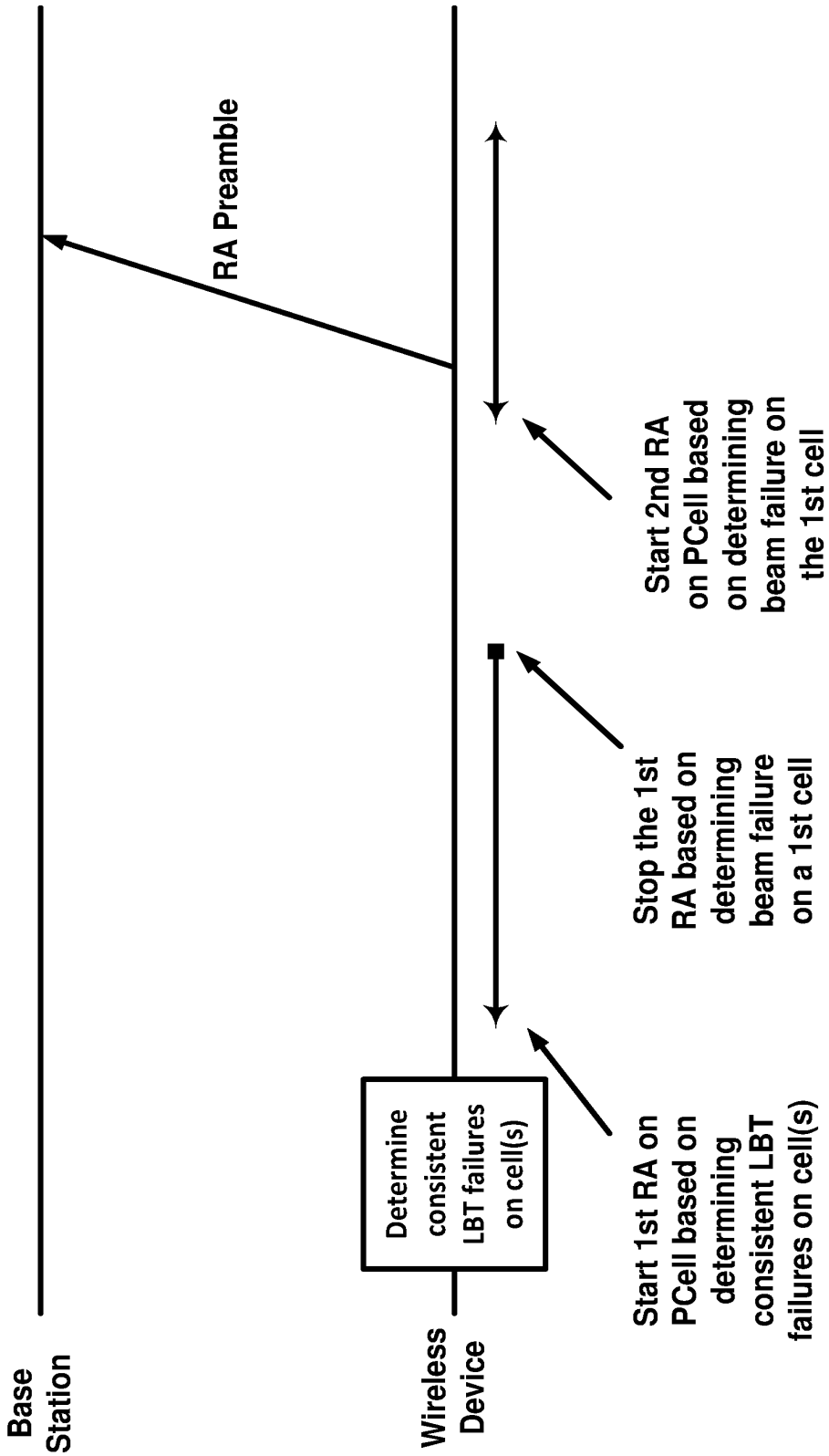
Base Station
Wireless Device
RA Preamble
Determine consistent LBT failures on cell(s)
Start 1st RA on PCell based on determining consistent LBT failures on cell(s)
Stop the 1st RA based on determining beam failure on a 1st cell
Start 2nd RA on PCell based on determining beam failure on the 1st cell

FIG. 24

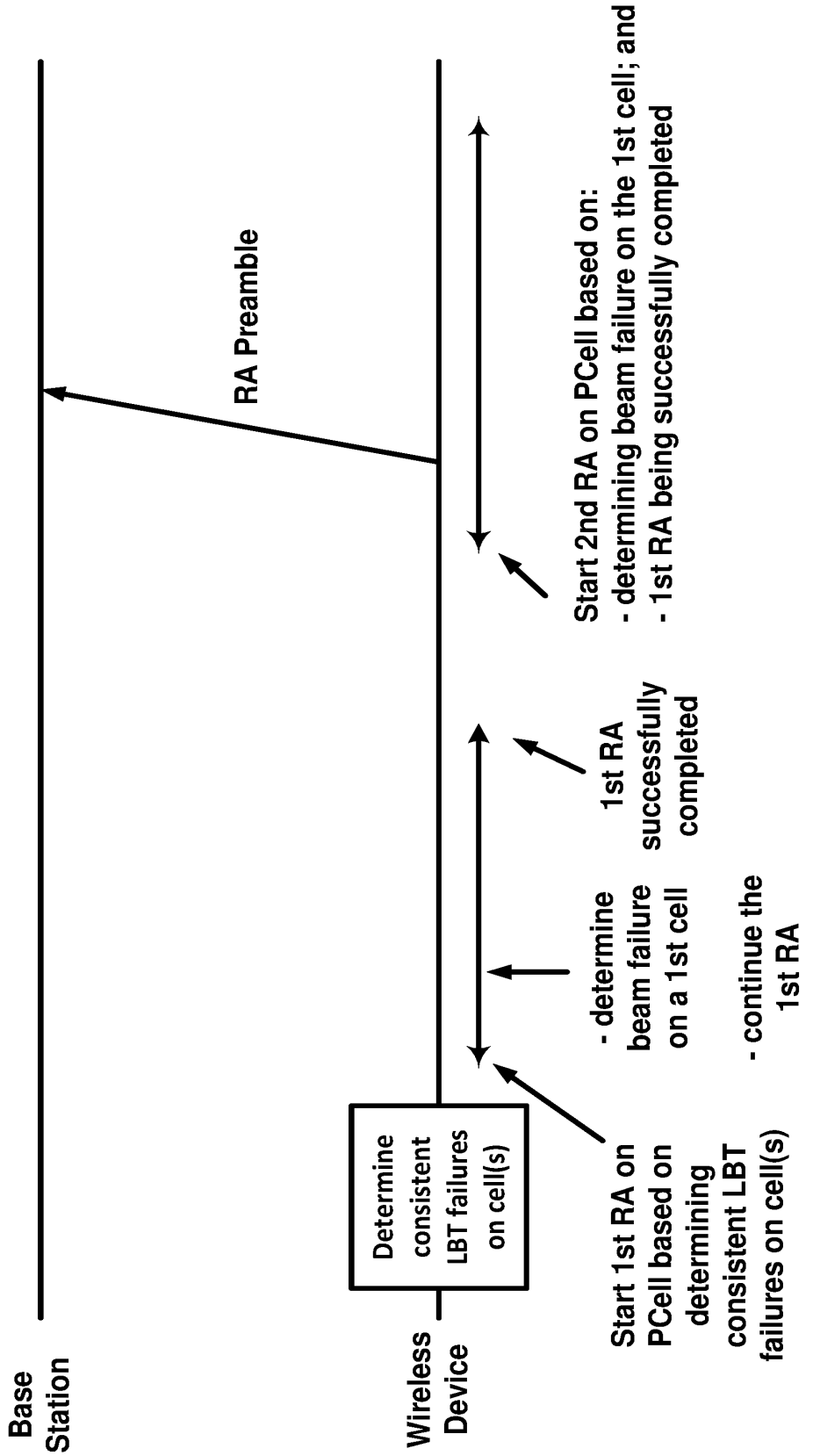
Base Station
Wireless Device
RA Preamble
Determine consistent LBT failures on cell(s)
Start 1st RA on PCell based on determining consistent LBT failures on cell(s)
- determine beam failure on a 1st cell
- continue the 1st RA
1st RA successfully completed
Start 2nd RA on PCell based on:
- determining beam failure on the 1st cell; and
- 1st RA being successfully completed

FIG. 25

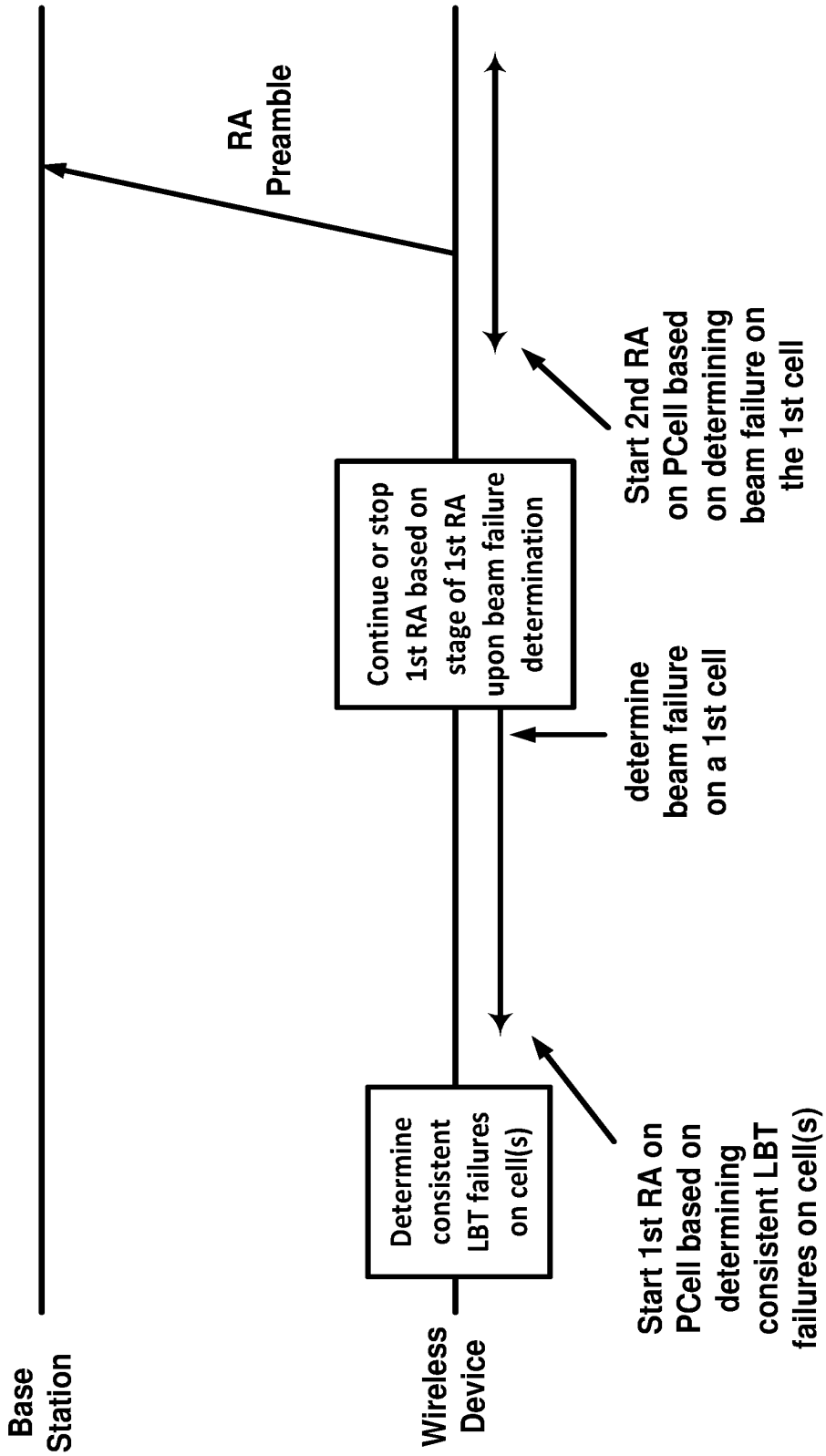
Base Station
Wireless Device
RA Preamble
Start 1st RA on PCell based on determining consistent LBT failures on cell(s)
Determine consistent LBT failures on cell(s)
determine beam failure on a 1st cell
Continue or stop 1st RA based on stage of 1st RA upon beam failure determination
Start 2nd RA on PCell based on determining beam failure on the 1st cell

FIG. 26

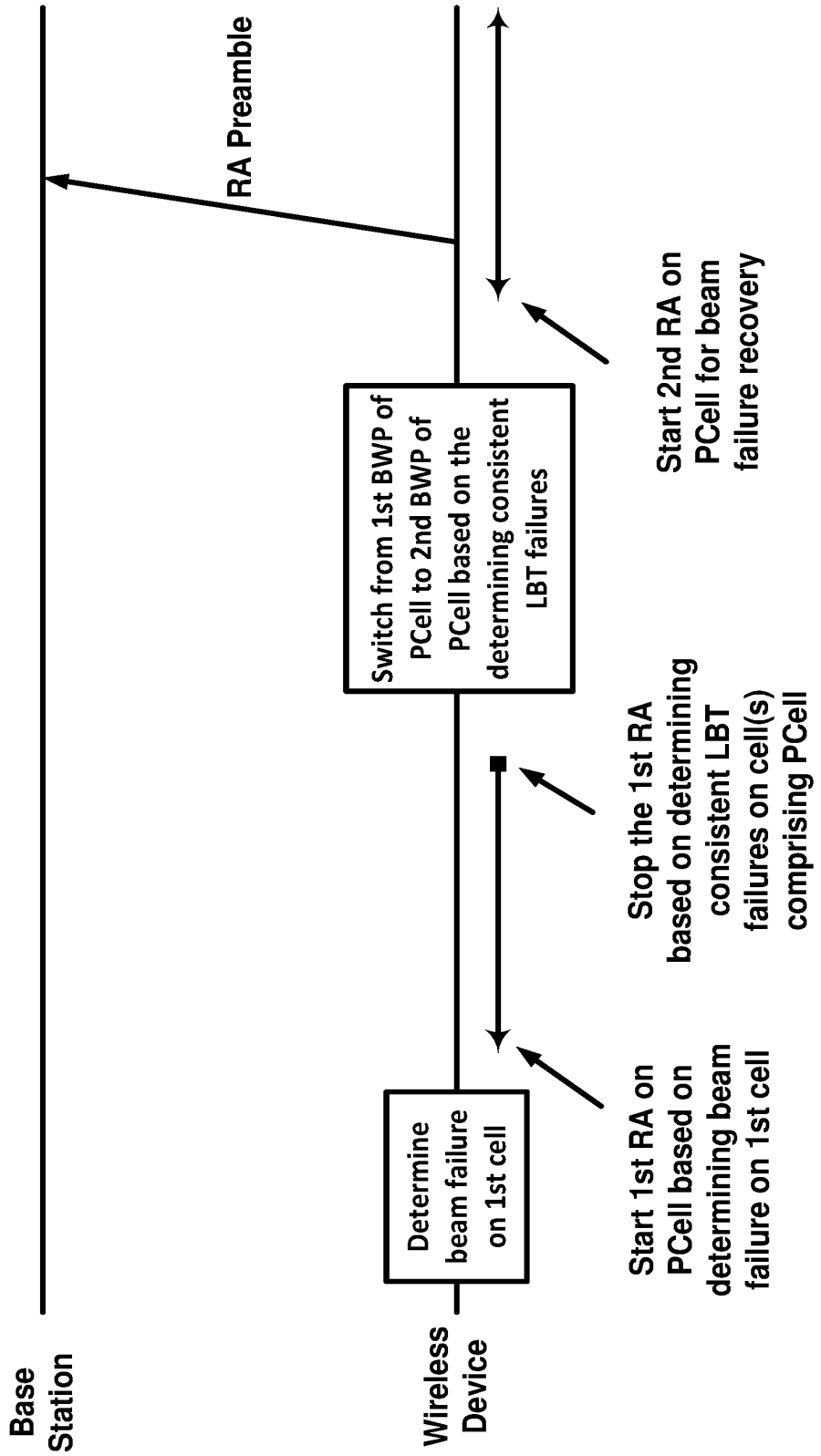
Base Station
Wireless Device
RA Preamble
Determine beam failure on 1st cell
Switch from 1st BWP of PCell to 2nd BWP of PCell based on the determining consistent LBT failures
Start 1st RA on PCell based on determining beam failure on 1st cell
Stop the 1st RA based on determining consistent LBT failures on cell(s) comprising PCell
Start 2nd RA on PCell for beam failure recovery

FIG. 27

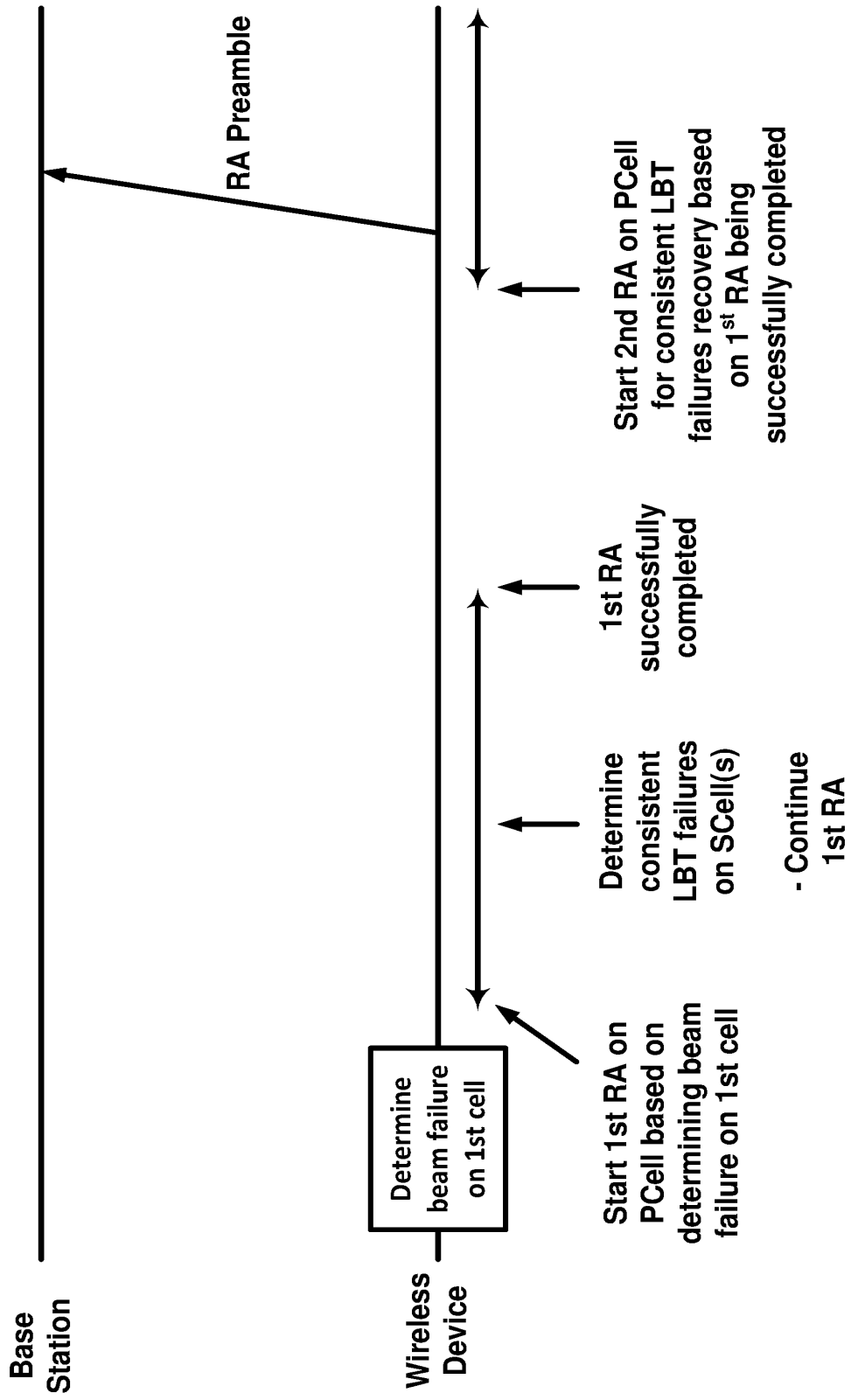
Base Station
Wireless Device
Determine beam failure on 1st cell
RA Preamble
Start 1st RA on PCell based on determining beam failure on 1st cell
Determine consistent LBT failures on SCell(s)
- Continue 1st RA
1st RA successfully completed
Start 2nd RA on PCell for consistent LBT failures recovery based on 1st RA being successfully completed

FIG. 28

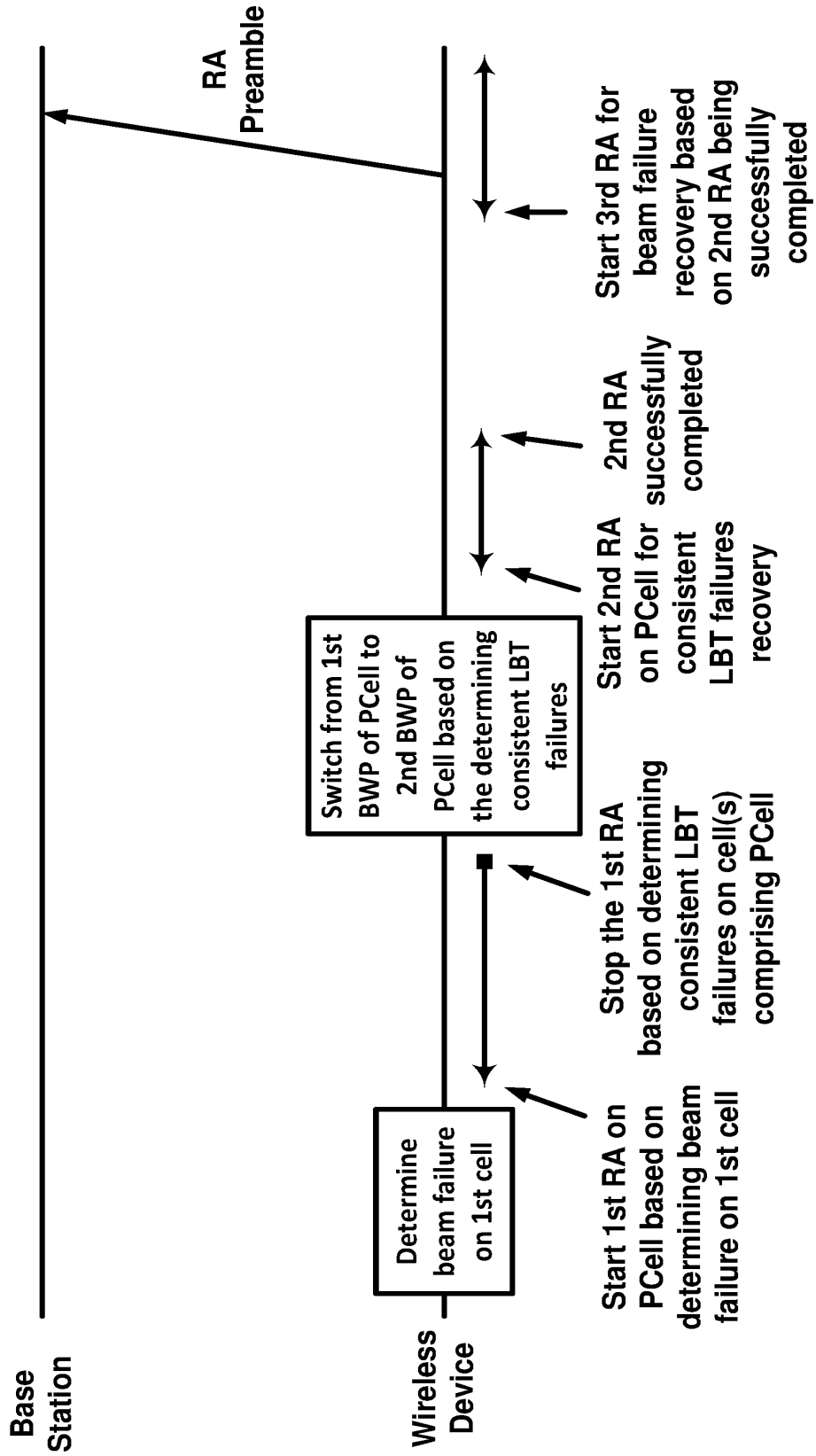
Base Station
Wireless Device
RA Preamble
Determine beam failure on 1st cell
Start 1st RA on PCell based on determining beam failure on 1st cell
Stop the 1st RA based on determining consistent LBT failures on cell(s) comprising PCell
Switch from 1st BWP of PCell to 2nd BWP of PCell based on the determining consistent LBT failures
Start 2nd RA on PCell for consistent LBT failures recovery
2nd RA successfully completed
Start 3rd RA for beam failure recovery based on 2nd RA being successfully completed

FIG. 29

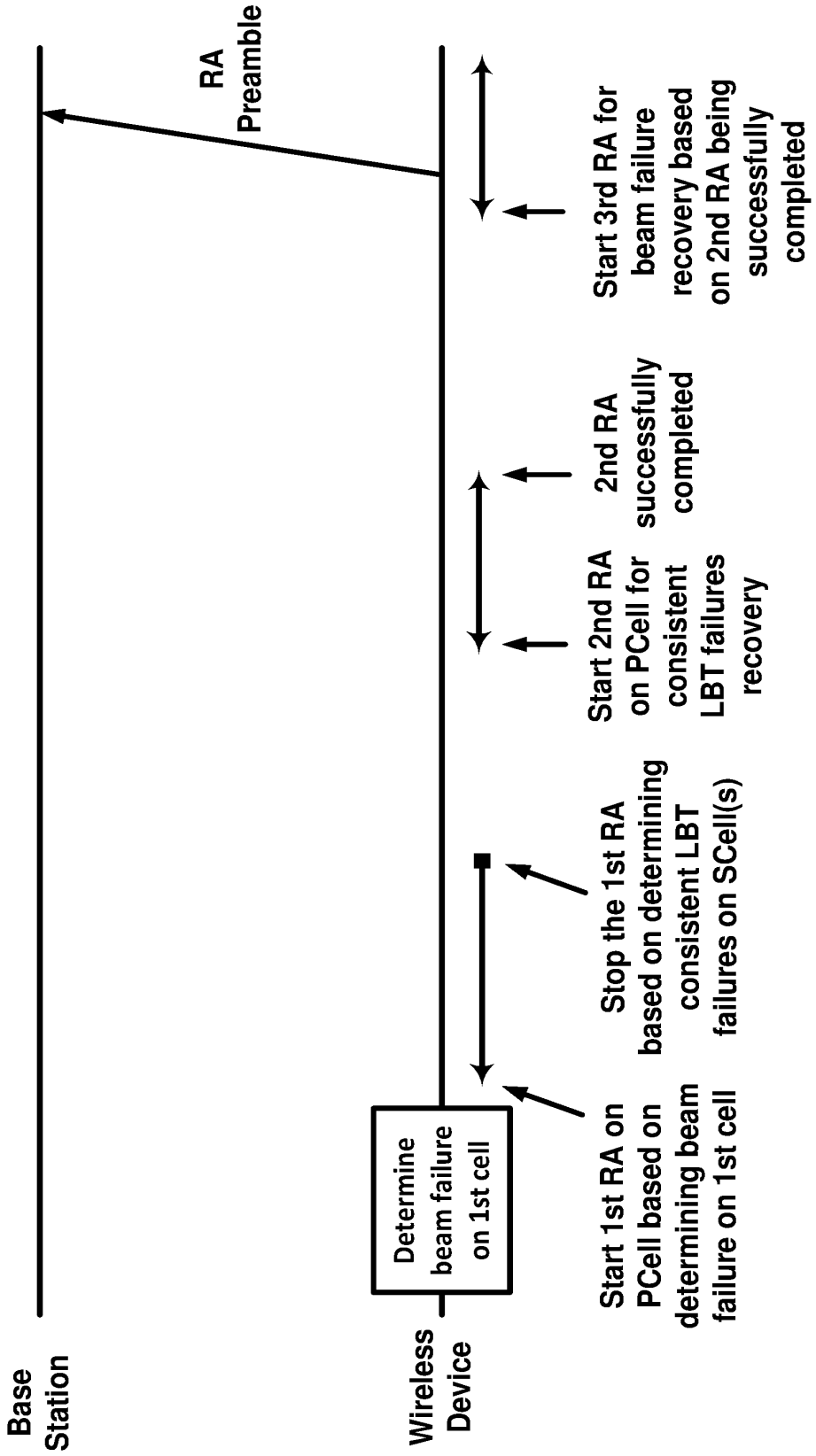
Base Station
Wireless Device
RA Preamble
Determine beam failure on 1st cell
Start 1st RA on PCell based on determining beam failure on 1st cell
Stop the 1st RA based on determining consistent LBT failures on SCell(s)
Start 2nd RA on PCell for consistent LBT failures recovery
2nd RA successfully completed
Start 3rd RA for beam failure recovery based on 2nd RA being successfully completed

FIG. 30

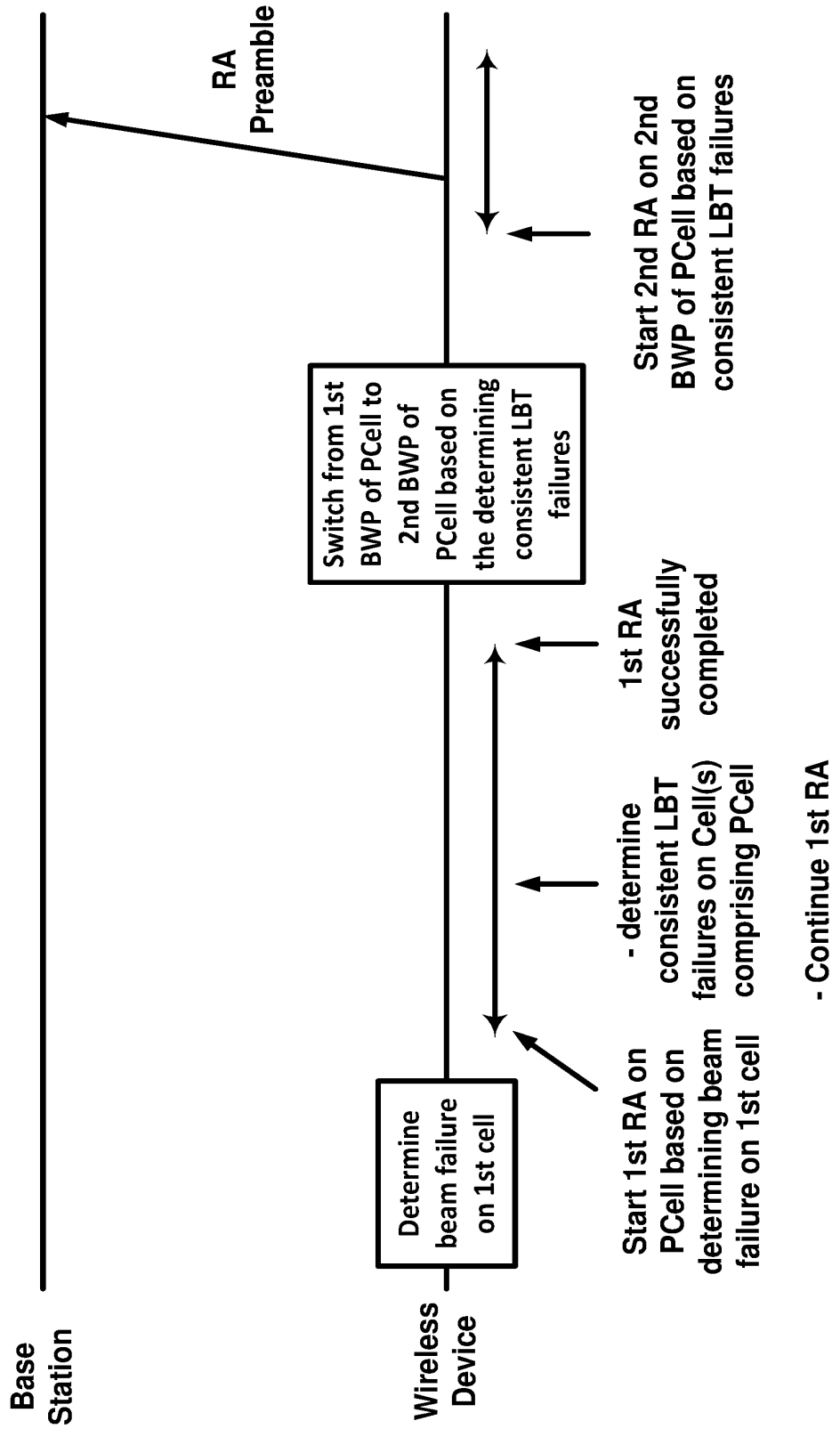
Base Station
Wireless Device
RA Preamble
Determine beam failure on 1st cell
Switch from 1st BWP of PCell to 2nd BWP of PCell based on the determining consistent LBT failures
Start 1st RA on PCell based on determining beam failure on 1st cell
- determine consistent LBT failures on Cell(s) comprising PCell
1st RA successfully completed
- Continue 1st RA
Start 2nd RA on 2nd BWP of PCell based on consistent LBT failures

FIG. 31

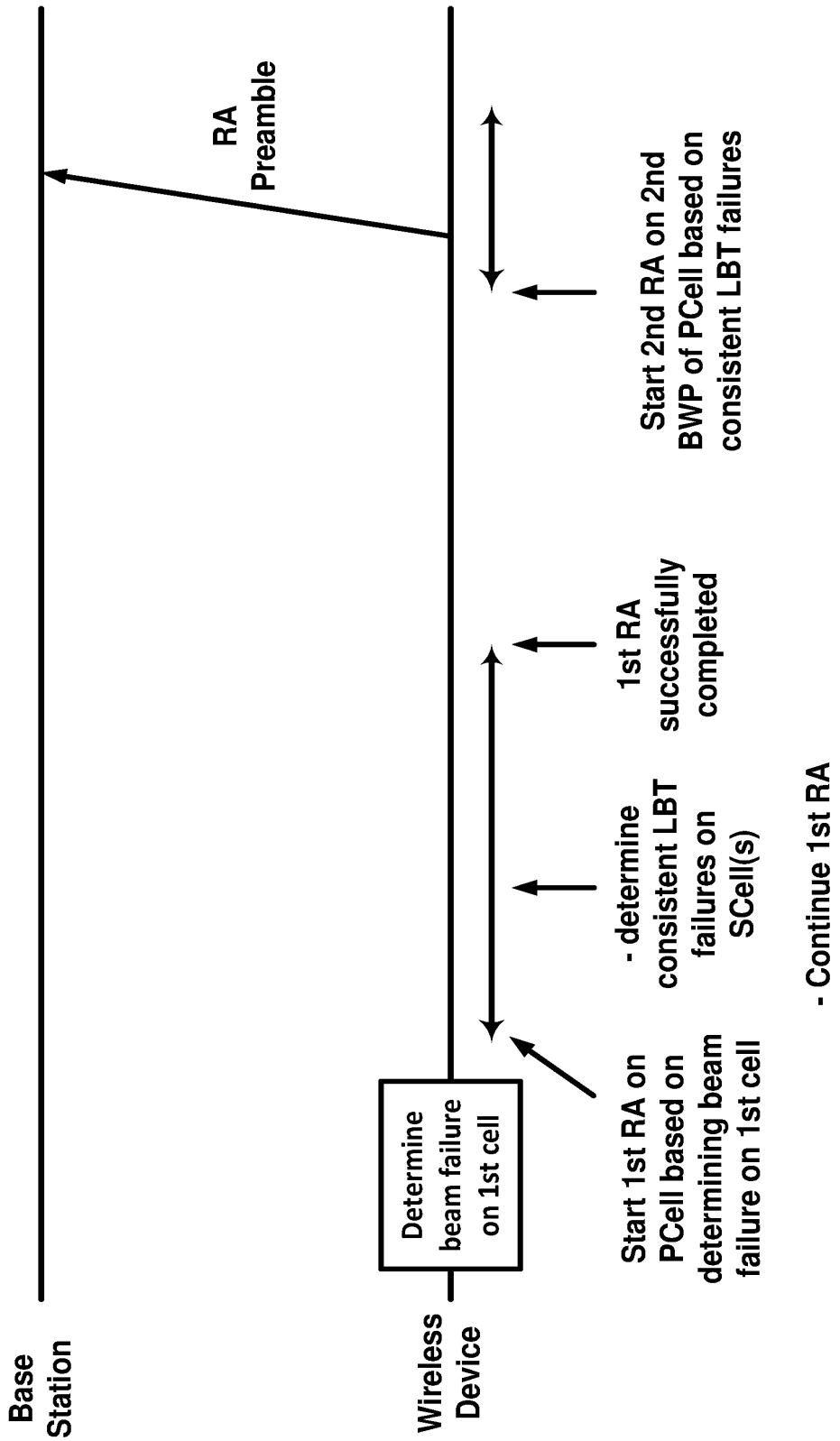
Base Station
Wireless Device
Determine beam failure on 1st cell
RA Preamble
Start 1st RA on PCell based on determining beam failure on 1st cell
- determine consistent LBT failures on SCell(s)
1st RA successfully completed
- Continue 1st RA
Start 2nd RA on 2nd BWP of PCell based on consistent LBT failures

FIG. 32

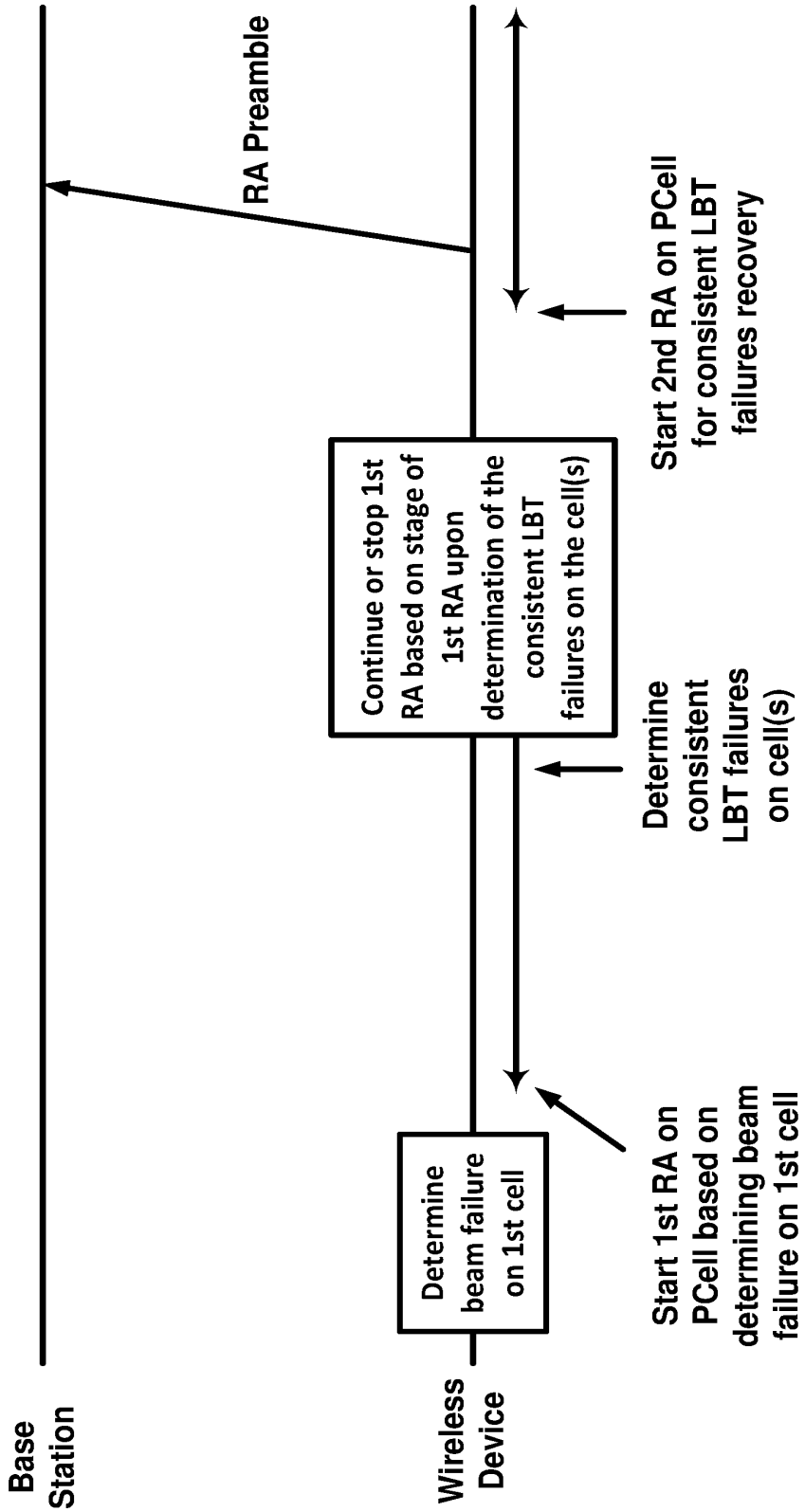
Base Station
Wireless Device
RA Preamble
Determine beam failure on 1st cell
Start 1st RA on PCell based on determining beam failure on 1st cell
Continue or stop 1st RA based on stage of 1st RA upon determination of the consistent LBT failures on the cell(s)
Determine consistent LBT failures on cell(s)
Start 2nd RA on PCell for consistent LBT failures recovery

FIG. 33

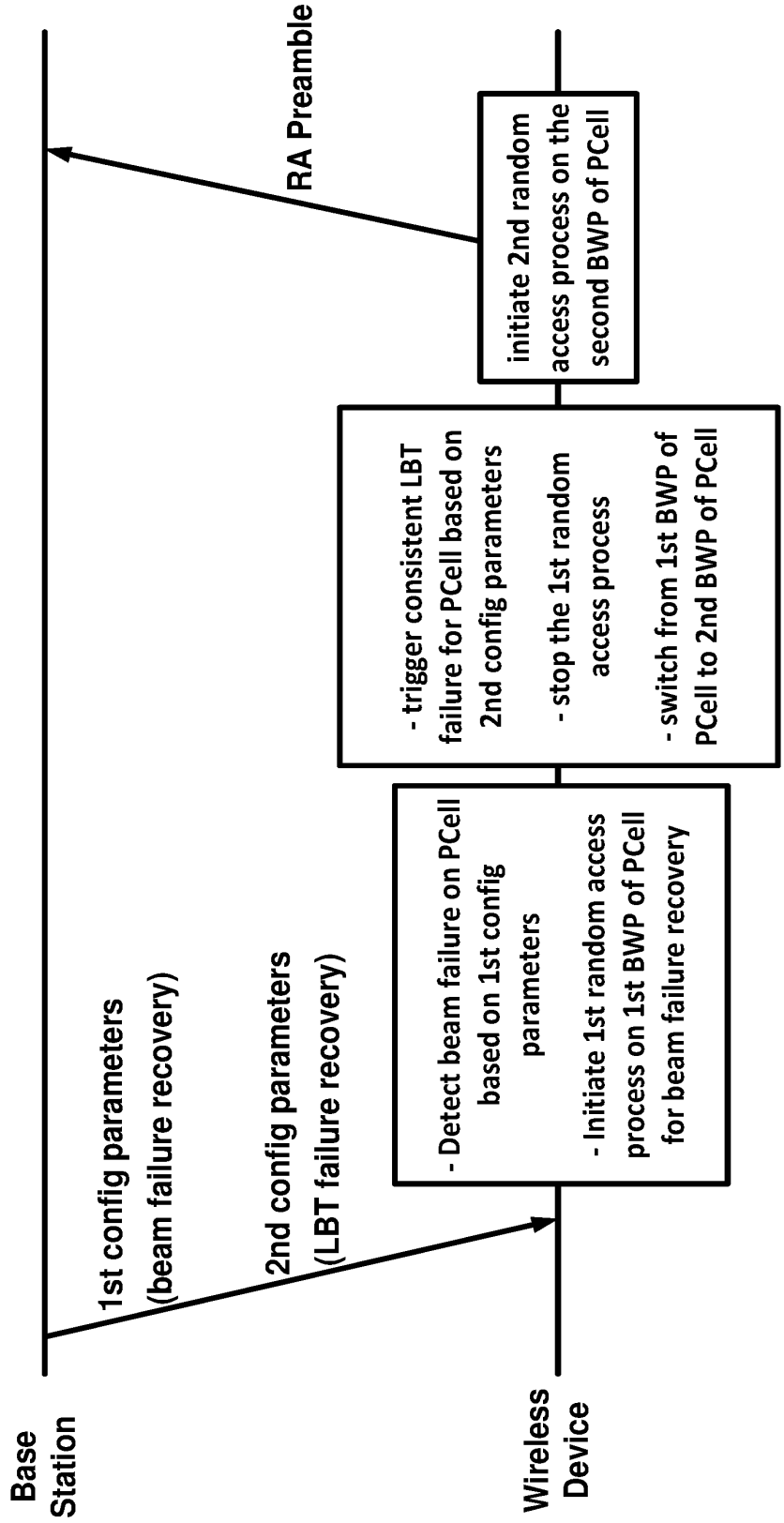
Base Station
Wireless Device
1st config parameters (beam failure recovery)
2nd config parameters (LBT failure recovery)
- Detect beam failure on PCell based on 1st config parameters
- Initiate 1st random access process on 1st BWP of PCell for beam failure recovery
- trigger consistent LBT failure for PCell based on 2nd config parameters
- stop the 1st random access process
- switch from 1st BWP of PCell to 2nd BWP of PCell
initiate 2nd random access process on the second BWP of PCell
RA Preamble

FIG. 34

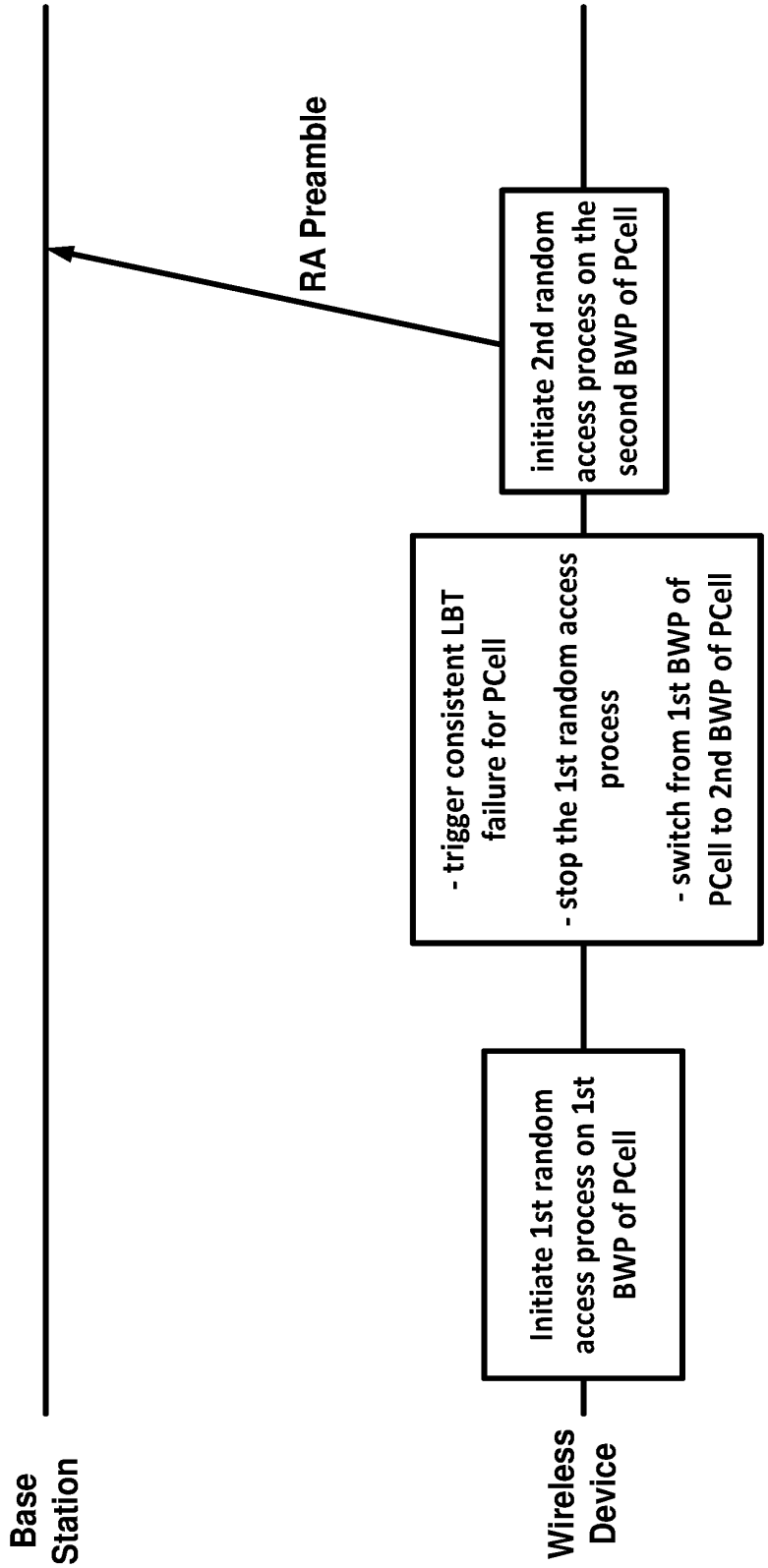
Base Station
Wireless Device
Initiate 1st random access process on 1st BWP of PCell
- trigger consistent LBT failure for PCell
- stop the 1st random access process
- switch from 1st BWP of PCell to 2nd BWP of PCell
initiate 2nd random access process on the second BWP of PCell
RA Preamble

FIG. 35

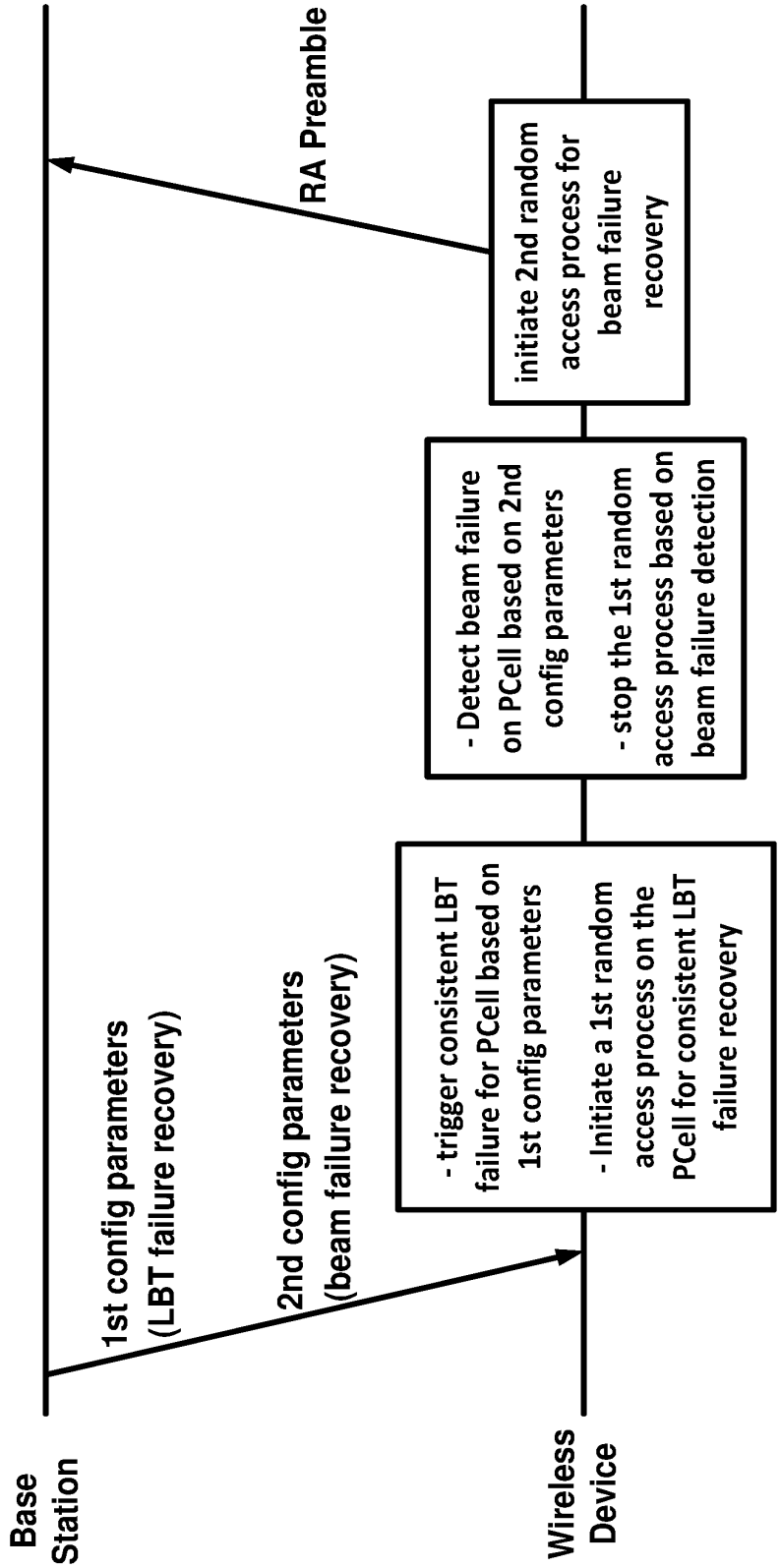
Base Station
Wireless Device
1st config parameters (LBT failure recovery)
2nd config parameters (beam failure recovery)
- trigger consistent LBT failure for PCell based on 1st config parameters
- Initiate a 1st random access process on the PCell for consistent LBT failure recovery
- Detect beam failure on PCell based on 2nd config parameters
- stop the 1st random access process based on beam failure detection
initiate 2nd random access process for beam failure recovery
RA Preamble

FIG. 36

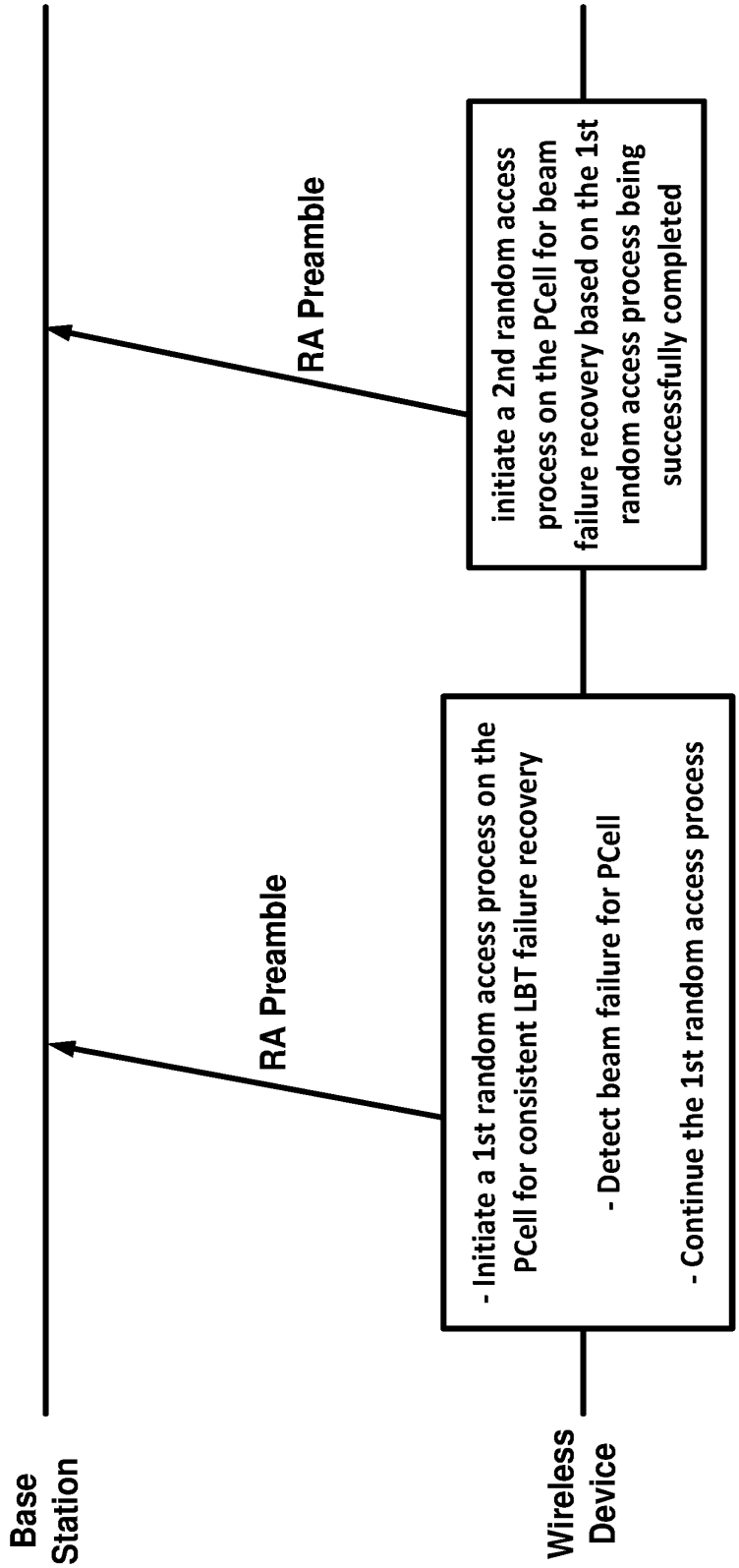
Base Station
Wireless Device
RA Preamble
- Initiate a 1st random access process on the PCell for consistent LBT failure recovery
- Detect beam failure for PCell
- Continue the 1st random access process
RA Preamble
initiate a 2nd random access process on the PCell for beam failure recovery based on the 1st random access process being successfully completed

FIG. 37

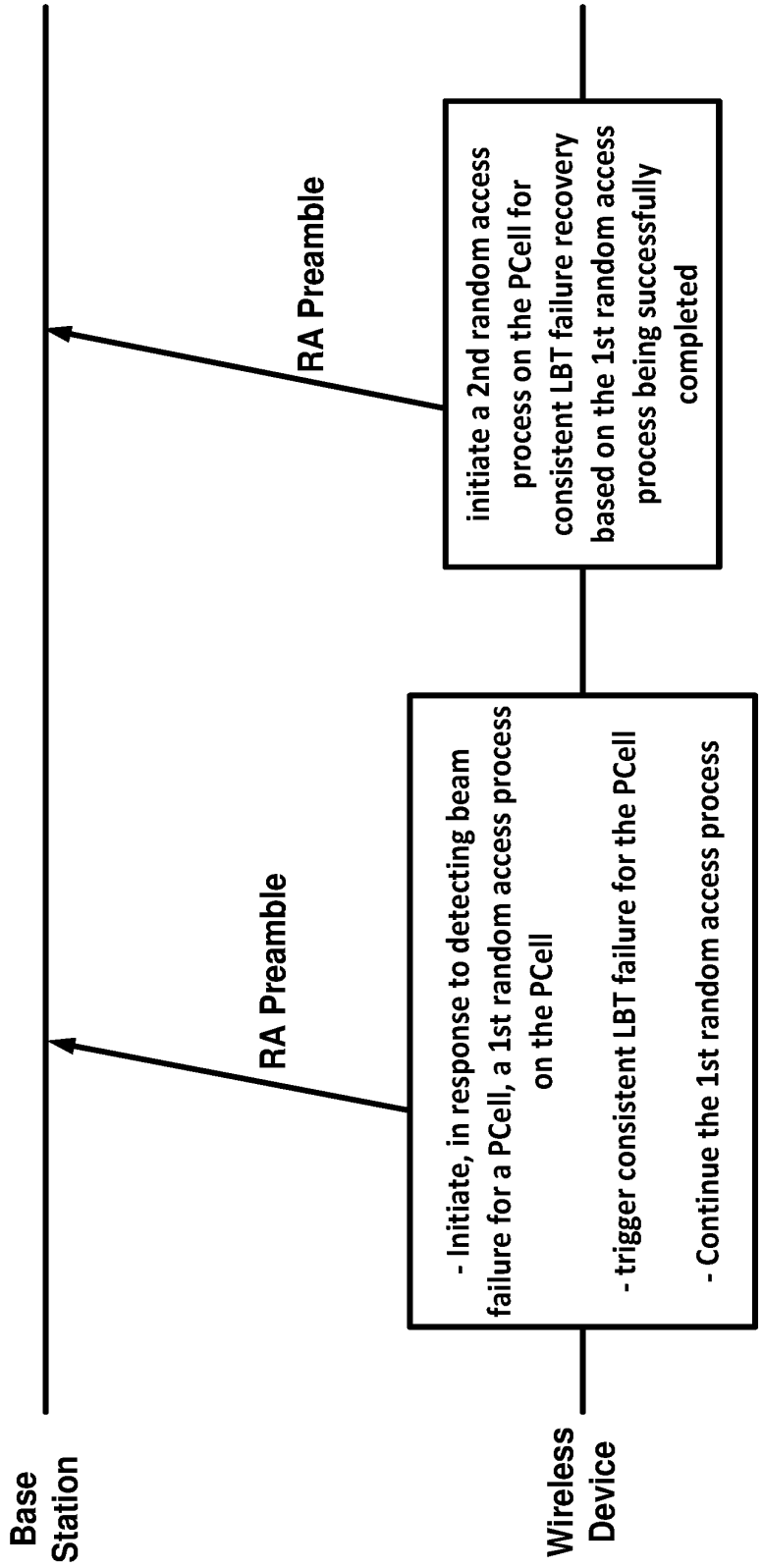
Base Station
Wireless Device
RA Preamble
- Initiate, in response to detecting beam failure for a PCell, a 1st random access process on the PCell
- trigger consistent LBT failure for the PCell
- Continue the 1st random access process
RA Preamble
initiate a 2nd random access process on the PCell for consistent LBT failure recovery based on the 1st random access process being successfully completed

FIG. 38

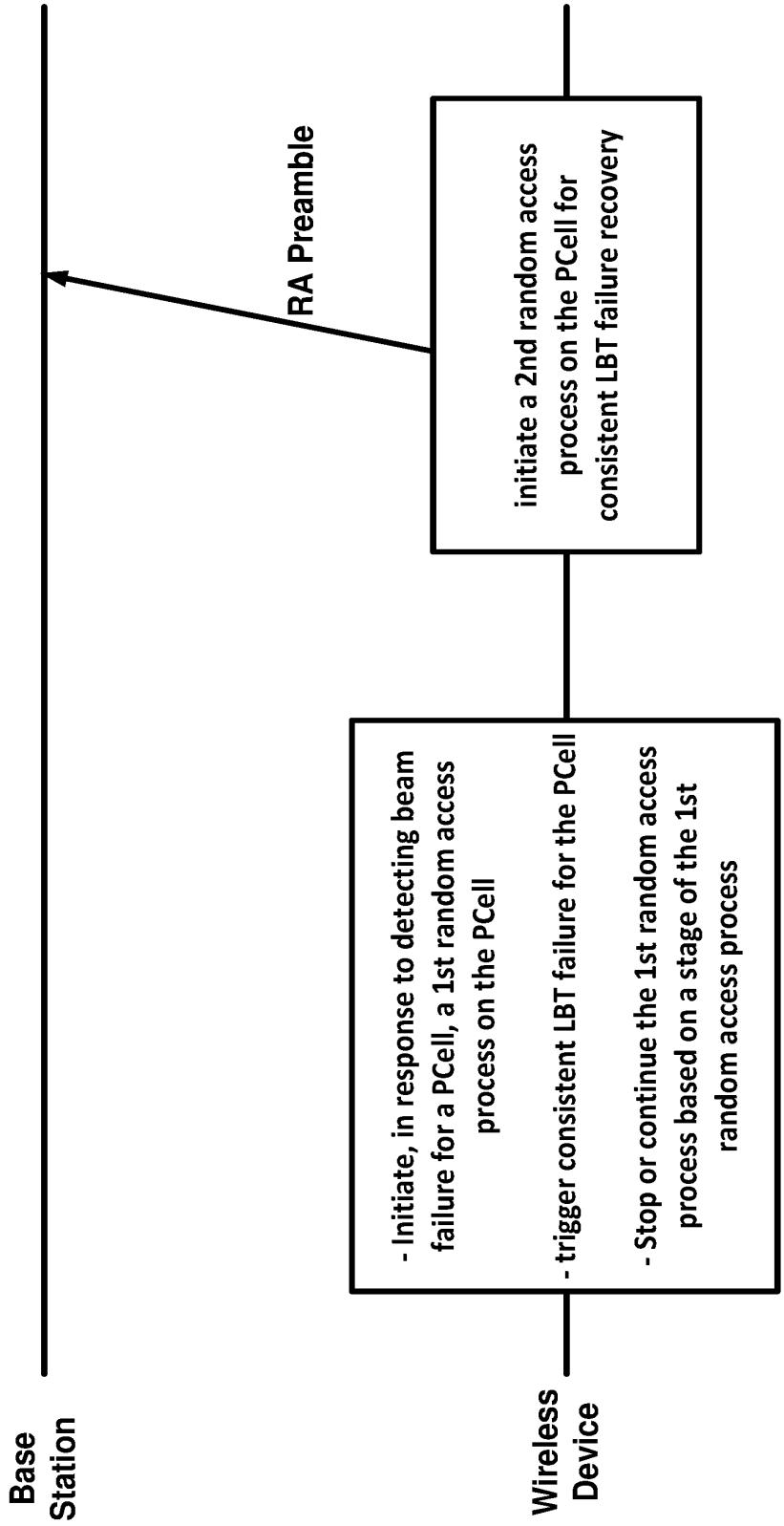
Base Station
Wireless Device
- Initiate, in response to detecting beam failure for a PCell, a 1st random access process on the PCell
- trigger consistent LBT failure for the PCell
- Stop or continue the 1st random access process based on a stage of the 1st random access process
RA Preamble
initiate a 2nd random access process on the PCell for consistent LBT failure recovery

FIG. 39

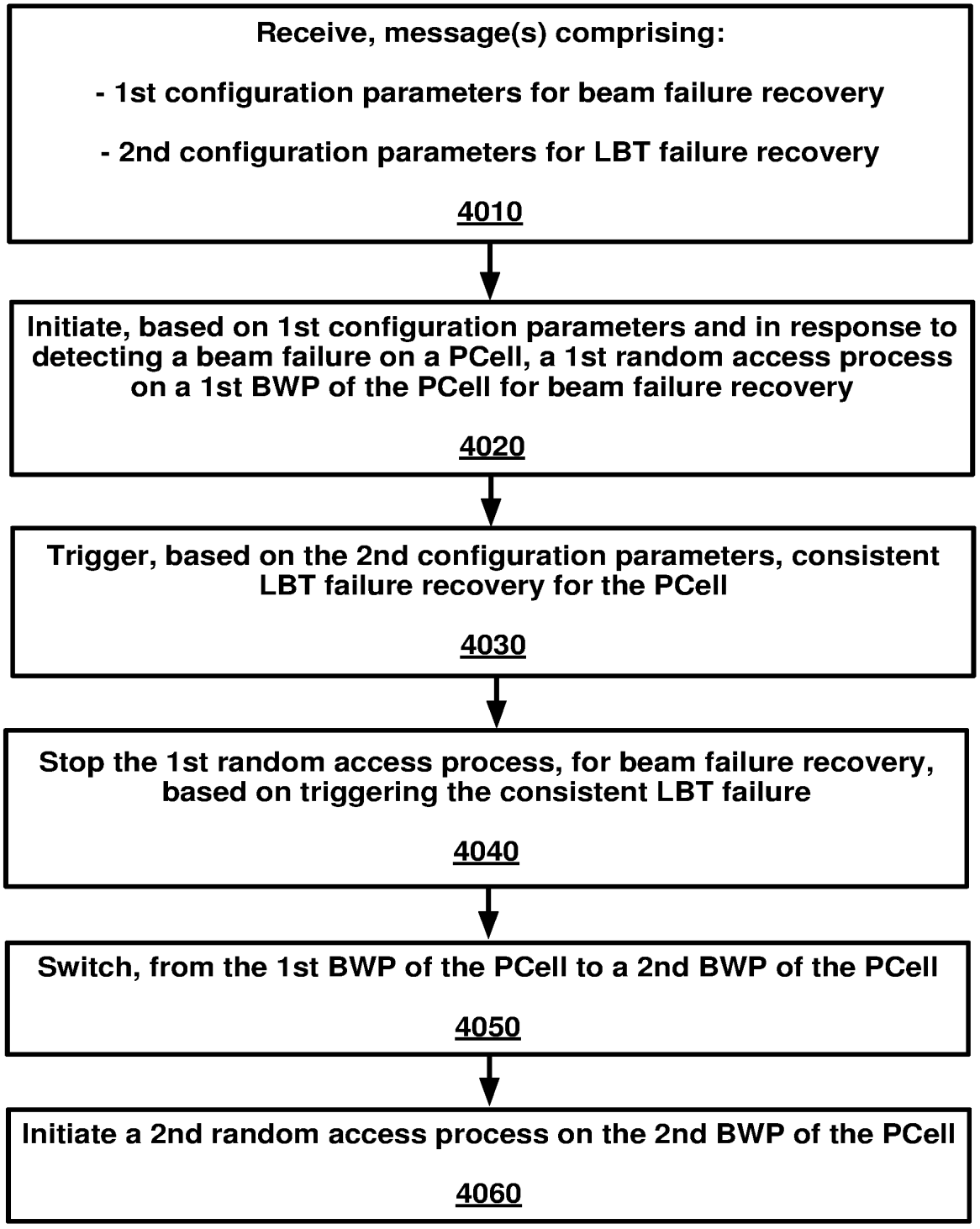
Receive, message(s) comprising:
- 1st configuration parameters for beam failure recovery
- 2nd configuration parameters for LBT failure recovery
4010
Initiate, based on 1st configuration parameters and in response to detecting a beam failure on a PCell, a 1st random access process on a 1st BWP of the PCell for beam failure recovery
4020
Trigger, based on the 2nd configuration parameters, consistent LBT failure recovery for the PCell
4030
Stop the 1st random access process, for beam failure recovery, based on triggering the consistent LBT failure
4040
Switch, from the 1st BWP of the PCell to a 2nd BWP of the PCell
4050
Initiate a 2nd random access process on the 2nd BWP of the PCell
4060

FIG. 40

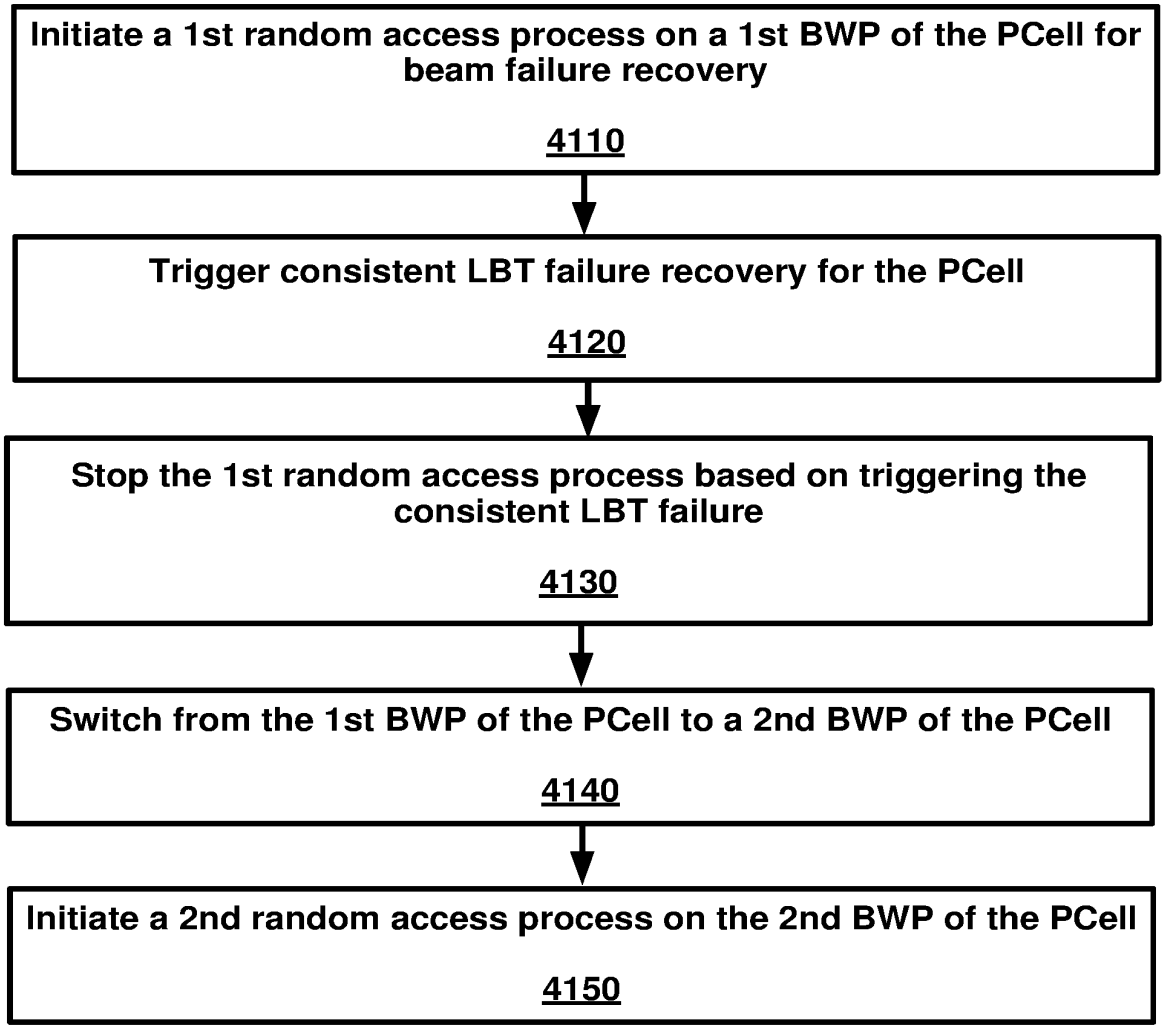
Initiate a 1st random access process on a 1st BWP of the PCell for beam failure recovery
4110
Trigger consistent LBT failure recovery for the PCell
4120
Stop the 1st random access process based on triggering the consistent LBT failure
4130
Switch from the 1st BWP of the PCell to a 2nd BWP of the PCell
4140
Initiate a 2nd random access process on the 2nd BWP of the PCell
4150

FIG. 41

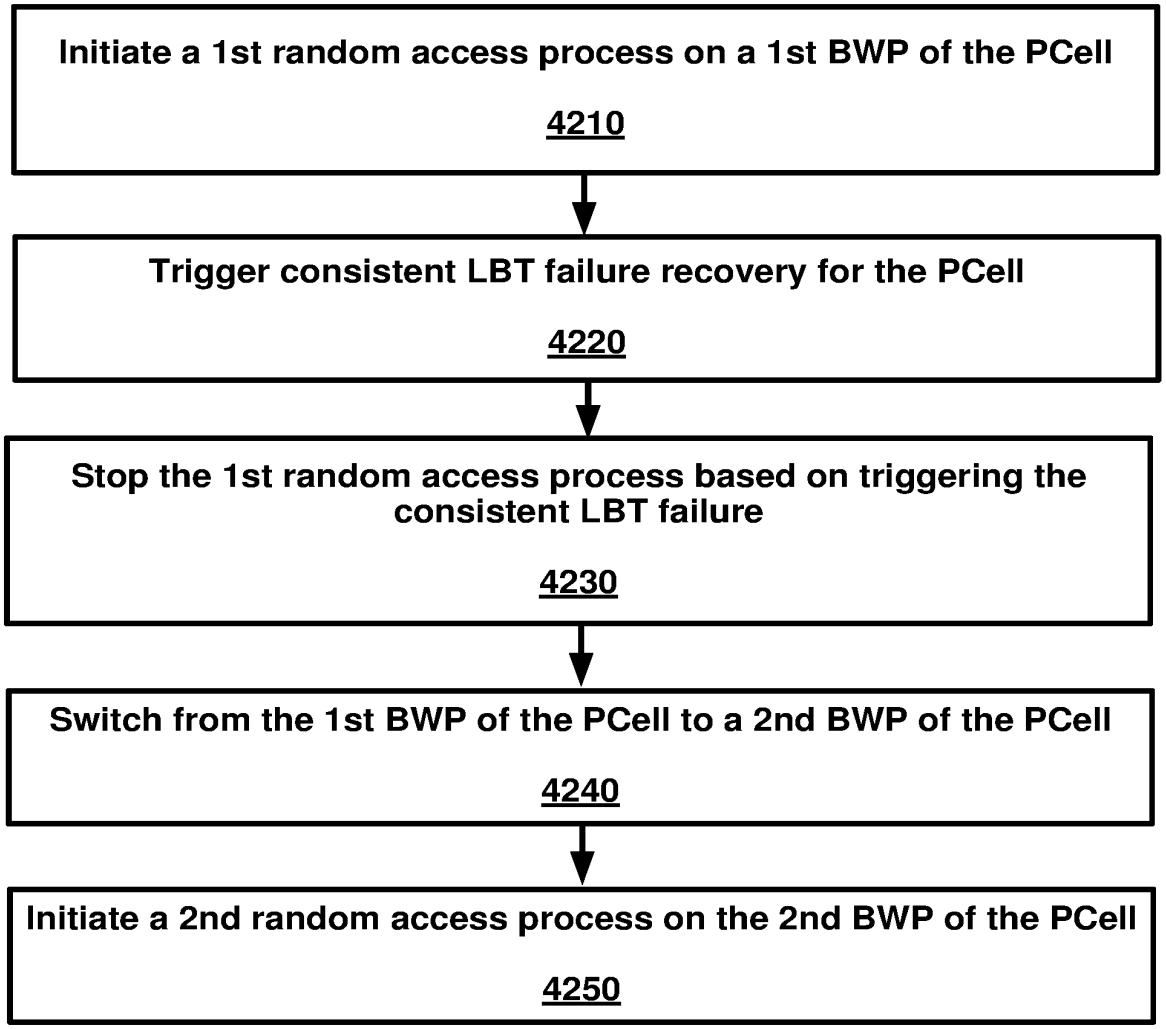
Initiate a 1st random access process on a 1st BWP of the PCell
4210
Trigger consistent LBT failure recovery for the PCell
4220
Stop the 1st random access process based on triggering the consistent LBT failure
4230
Switch from the 1st BWP of the PCell to a 2nd BWP of the PCell
4240
Initiate a 2nd random access process on the 2nd BWP of the PCell
4250

FIG. 42

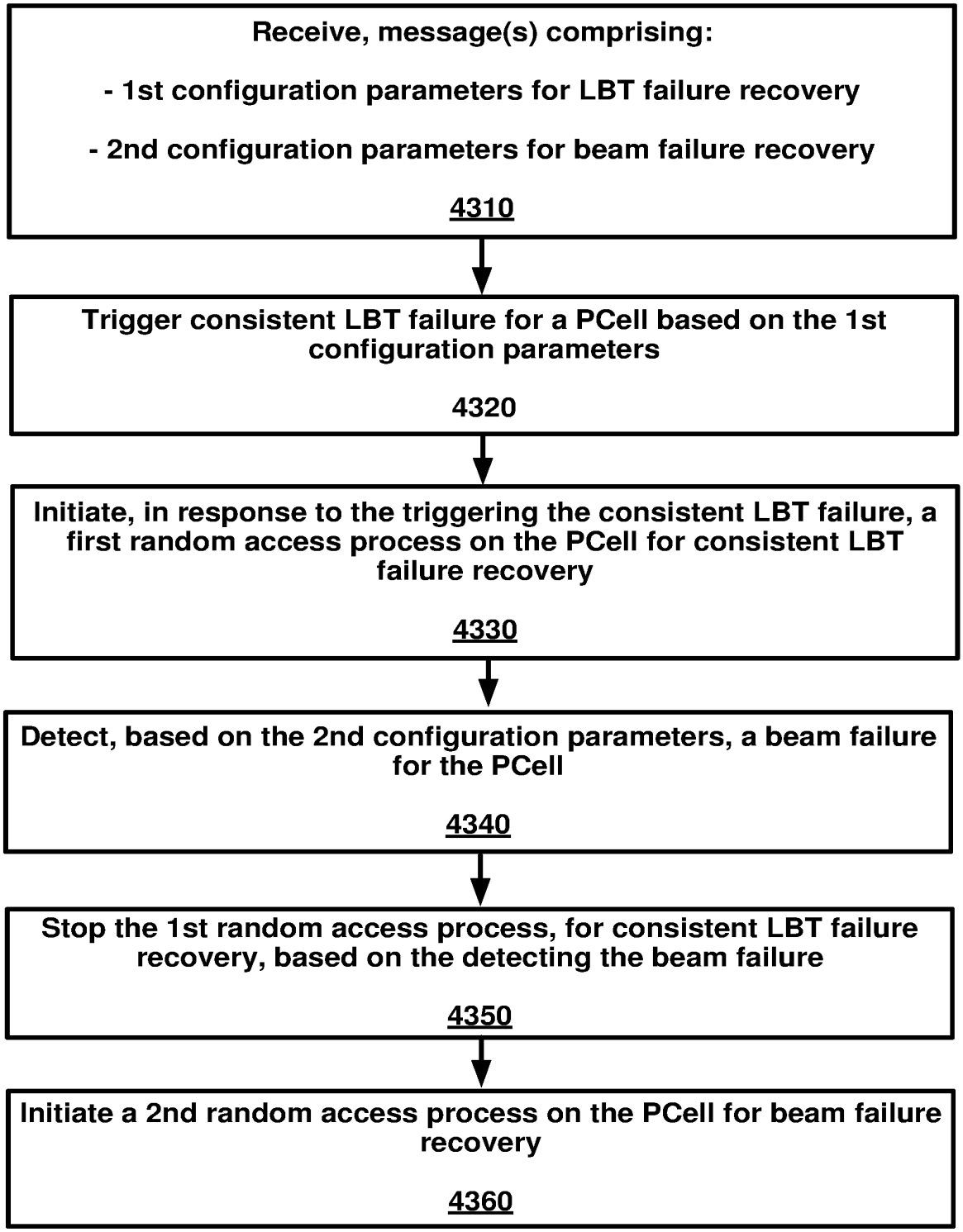
Receive, message(s) comprising:
- 1st configuration parameters for LBT failure recovery
- 2nd configuration parameters for beam failure recovery
4310
Trigger consistent LBT failure for a PCell based on the 1st configuration parameters
4320
Initiate, in response to the triggering the consistent LBT failure, a first random access process on the PCell for consistent LBT failure recovery
4330
Detect, based on the 2nd configuration parameters, a beam failure for the PCell
4340
Stop the 1st random access process, for consistent LBT failure recovery, based on the detecting the beam failure
4350
Initiate a 2nd random access process on the PCell for beam failure recovery
4360

FIG. 43

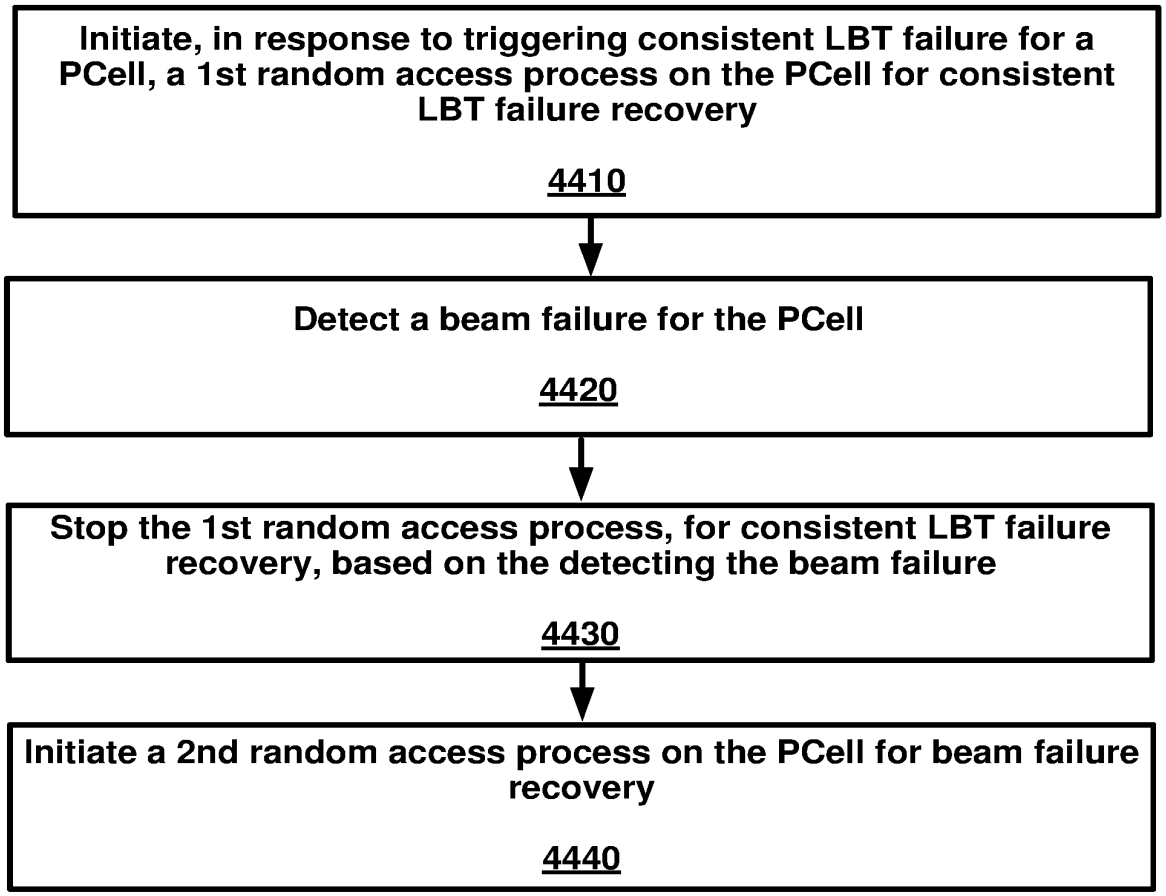
Initiate, in response to triggering consistent LBT failure for a PCell, a 1st random access process on the PCell for consistent LBT failure recovery
4410
Detect a beam failure for the PCell
4420
Stop the 1st random access process, for consistent LBT failure recovery, based on the detecting the beam failure
4430
Initiate a 2nd random access process on the PCell for beam failure recovery
4440

FIG. 44

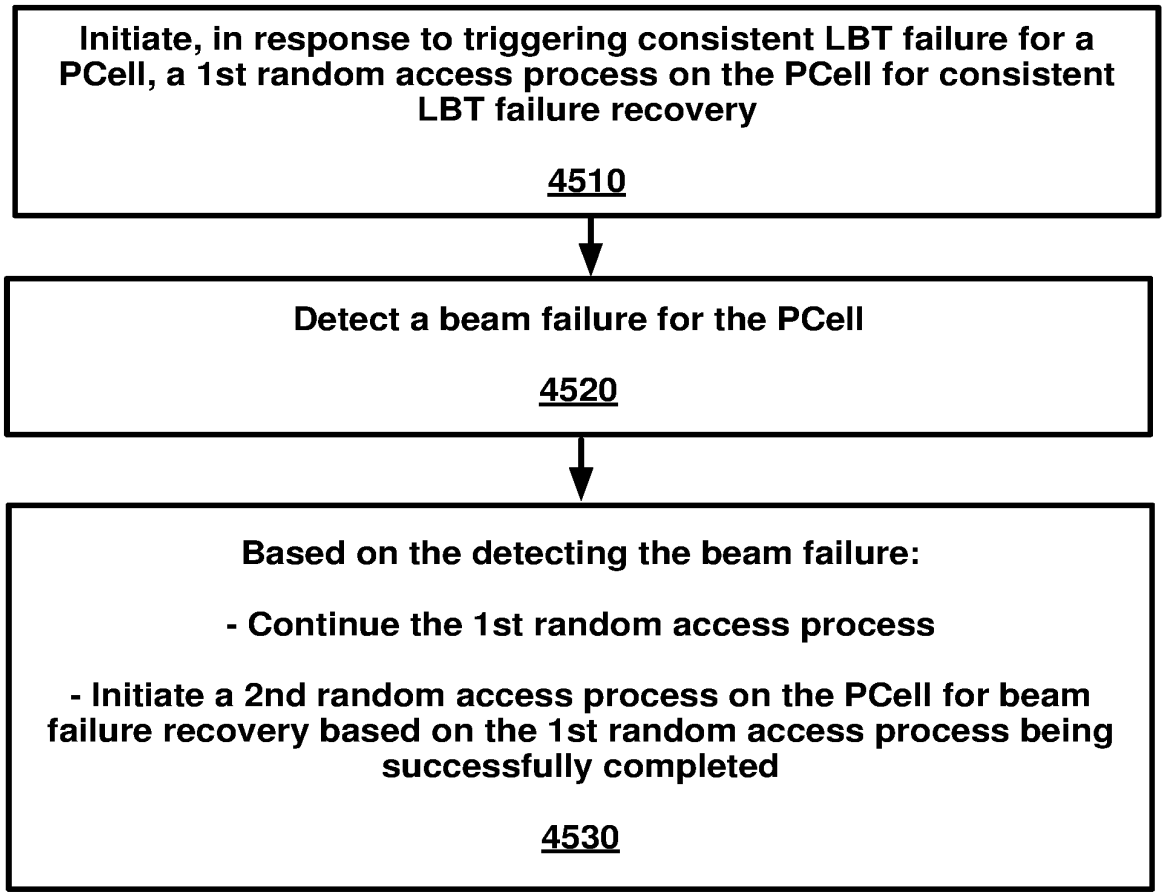
Initiate, in response to triggering consistent LBT failure for a PCell, a 1st random access process on the PCell for consistent LBT failure recovery
4510
Detect a beam failure for the PCell
4520
Based on the detecting the beam failure:
- Continue the 1st random access process
- Initiate a 2nd random access process on the PCell for beam failure recovery based on the 1st random access process being successfully completed
4530

FIG. 45

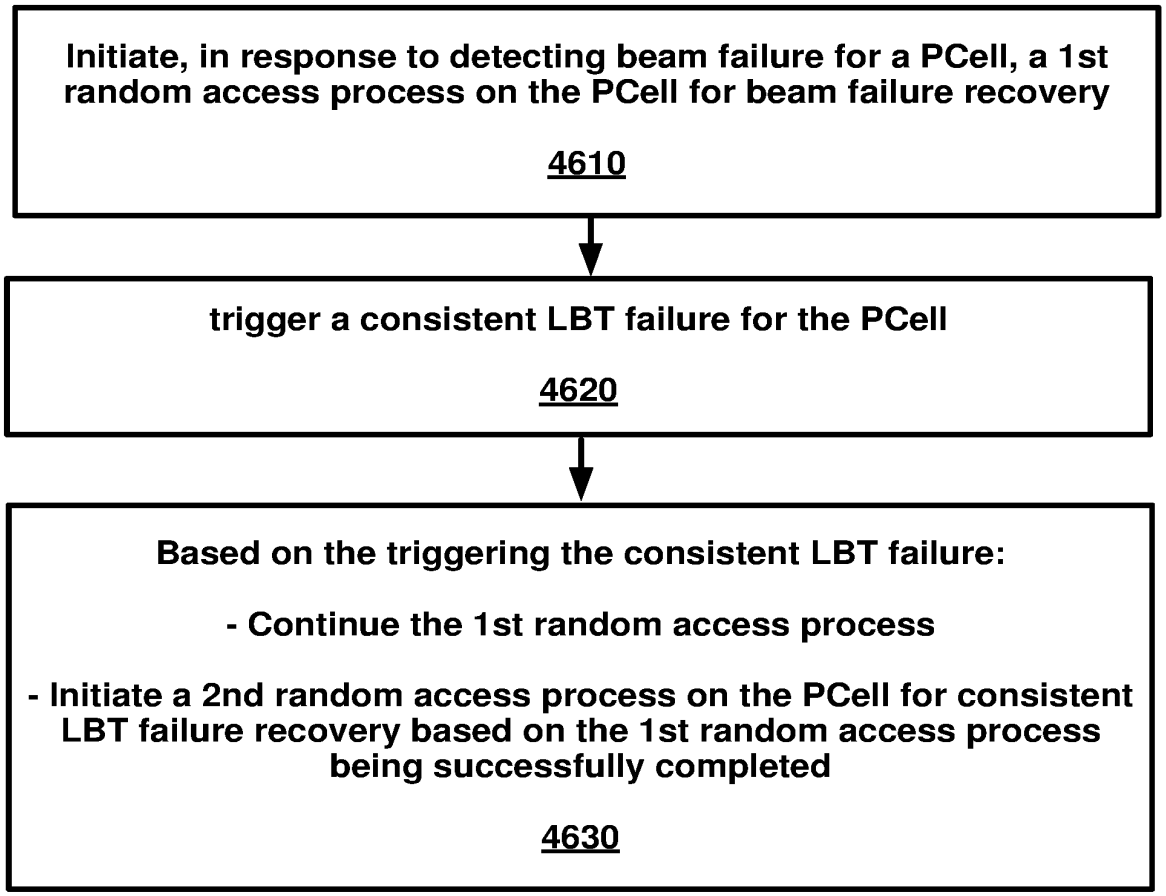
Initiate, in response to detecting beam failure for a PCell, a 1st random access process on the PCell for beam failure recovery
4610
trigger a consistent LBT failure for the PCell
4620
Based on the triggering the consistent LBT failure:
- Continue the 1st random access process
- Initiate a 2nd random access process on the PCell for consistent LBT failure recovery based on the 1st random access process being successfully completed
4630

FIG. 46

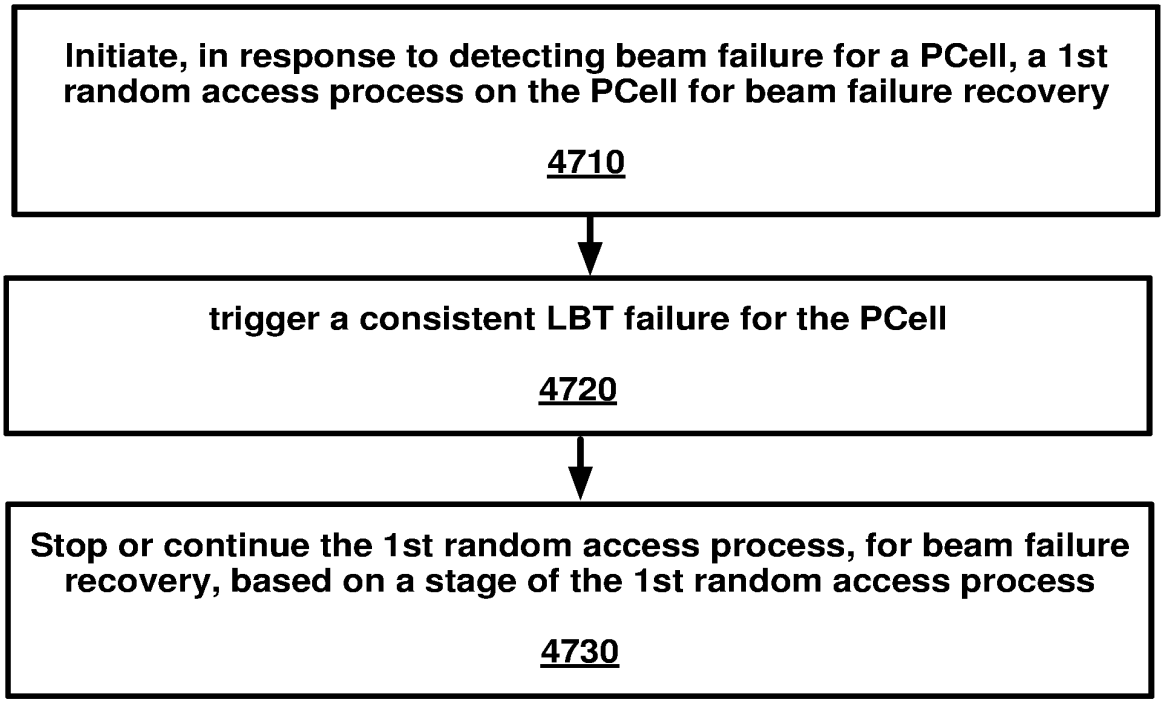
Initiate, in response to detecting beam failure for a PCell, a 1st random access process on the PCell for beam failure recovery
4710
trigger a consistent LBT failure for the PCell
4720
Stop or continue the 1st random access process, for beam failure recovery, based on a stage of the 1st random access process
4730

FIG. 47

ABSTRACT

A wireless device receives message(s) comprising: first configuration parameters for beam failure recovery; and second configuration parameters for LBT failure recovery. The wireless device initiates, based on the first configuration parameters and in response to detecting a beam failure on a primary cell, a first random access process on a first BWP of the primary cell for beam failure recovery. The wireless device triggers, based on the second configuration parameters, consistent LBT failure for the primary cell. The wireless device stops the first random access process, for the beam failure recovery, based on the triggering the consistent LBT failure. The wireless device switches from the first BWP of the primary cell to a second BWP of the primary cell as an active BWP of the primary cell. The wireless device initiates a second random access process on the second BWP of the primary cell.

PTO/AIA/01 (06-12)
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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	BEAM FAILURE AND CONSISTENT LISTEN BEFORE TALK FAILURE RECOVERY

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [x] The attached application, or
- [ ] United States application or PCT international application number _____

filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

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Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Alireza Babaei Date (Optional) :_____

Signature: /Alireza Babaei/

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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