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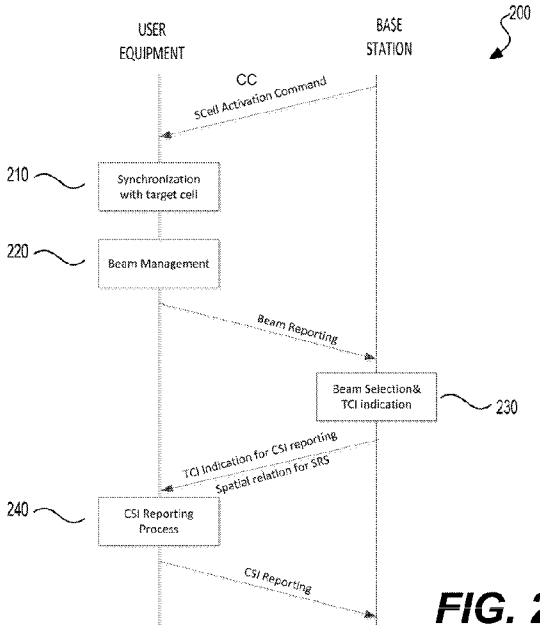

FIG. 2

(57) Abstract: This invention proposes a mechanism of SCell activation in a wireless communication network. The mechanism is used for an mmWave Scell activation scenario. When the SCell to be activated is the first SCell in mmWave, the processing could include Scell identification, L1-RSRP beam management, L1-RSRP beam reporting, CSI reporting process in UE side. The processing also include SCell activation command trigger, beam selection and TCI and spatial relation indication in network side. The UE could use beam management to find the N best beams and report the beam index to the network. The network could indicate the TCI state and spatial relation for the reporting CSI and SRS based on the beam reporting by UE. Alternatively, the method could include this SCell measurement reporting with beam index in deactivated state, and Scell identification, CSI reporting process in UE side. The processing also include SCell activation command trigger, beam selection and TCI and spatial relation indication in network side. The UE could

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[Continued on next page]

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use deactivated SCell's measurement to report the beam index to the network. The network could indicate the TCI state and spatial relation for the reporting CSI and SRS based on the deactivated SCell's measurement reporting by UE. When the SCell to be activated is not the first SCell in mmWave, the SCell's CSI reporting TCI state and SRS spatial relation could rely on exist PCell/PSCell or any activated serving cell. The processing could include Scell identification, CSI reporting process in UE after SCell activation command triggered in network.

METHODS AND APPARATUS OF SCELL ACTIVATION IN NEW RADIO SYSTEM

TECHNICAL FIELD

[0001]The present disclosure relates to wireless communications, and particularly relates to SCell activation processing in a New Radio system.

BACKGROUND

[0002]The background description provided herein is for the purpose of generally presenting the context of the disclosure. Work of the presently named inventors, to the extent the work is described in this background section, as well as aspects of the description that may not otherwise qualify as prior art at the time of filing, are neither expressly nor impliedly admitted as prior art against the present disclosure.

[0003]The 5G New Radio (NR) system is designed to support sub-6GHz and mmWave. In mmWave, the NR system needs beam management process to set up the suitable Tx-Rx beam pair. To support higher throughput, the system could be deployed with carrier aggregation (CA) or dual-connection (DC) techniques. The network could activate one or multiple SCell(s) to increase the system throughput in CA or DC scenarios.

[0004]In LTE and NR sub-6GHz SCell activation, the procedure should be SCell identification and CSI reporting. After UE receiving the SCell activation command by MAC-CE, UE should execute AGC retuning, cell search, fine synchronization, MIB reading for SCell identification. After SCell identification, the UE will calculate the CSI and reporting the CSI to the Base Station (BS). Nevertheless, in NR mmWave, UE need to handle beam management to acquire the CSI beam information before CSI reporting. At the same time, the UE also need to know the spatial relation for SRS before SRS transmission in SCell. Accordingly, the mechanism of SCell activation in NR mmWave system is important.

SUMMARY

[0005]Aspects of the disclosure provide a mechanism of SCell activation in a wireless communication network, especially in NR system. The mechanism is used for an mmWave Scell activation scenario. When the SCell to be activated is the first SCell in mmWave, the processing could include Scell identification, L1-RSRP beam management, L1-RSRP beam reporting, CSI reporting process in UE side. The processing also include SCell activation command trigger, beam selection and TCI and spatial relation indication in network side. The UE could use beam management to find the N best beams and report the beam index to the network. The network could indicate the TCI state and spatial relation for the reporting CSI and SRS based on the beam reporting by UE. Alternatively, the method could include this SCell measurement reporting with beam index in deactivated state, and Scell identification, CSI reporting process in UE side. The processing also include SCell activation command trigger, beam selection and TCI and spatial relation indication in network side. The UE could use deactivated SCell's measurement to report the beam index to the network. The network could indicate the TCI state and spatial relation

for the reporting CSI and SRS based on the deactivated SCell's measurement reporting by UE. When the SCell to be activated is not the first SCell in mmWave, the SCell's CSI reporting TCI state and SRS spatial relation could rely on exist PCell/PSCell or any activated serving cell. The processing could include Scell identification, CSI reporting process in UE after SCell activation command triggered in network.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006]Various embodiments of this disclosure that are proposed as examples will be described in detail with reference to the following figures, wherein like numerals reference like elements, and wherein:

[0007]Fig. 1 shows a wireless communication system according to an embodiment of the disclosure;

[0008]Fig. 2 shows an example of SCell activation procedure according to an embodiment of the disclosure;

[0009]Fig. 3 shows an example of SCell activation procedure according to an embodiment of the disclosure;

[0010]Fig. 4 shows an example of SCell activation procedure according to an embodiment of the disclosure;

[0011]Fig. 5 shows an exemplary block diagram of a user equipment (UE) according to an embodiment of the disclosure.

DETAILED DESCRIPTION OF EMBODIMENTS

[0012]Fig. 1 shows a wireless communication system 100 according to an embodiment of the disclosure. The system 100 can include a user equipment (UE) 110 and a base station (BS) 120. The system 100 can be a cellular network, and employ the New Radio (NR) technologies and the LTE technologies developed by the 3rd Generation Partnership Project (3GPP) for wireless communications between the UE 110 and the BS 120. The UE 110 can be a mobile phone, a laptop computer, a device carried in a vehicle, and the like. The BS 120 can be an implementation of a gNB specified in NR standards. Accordingly, the UE 110 can communicate with the base station 120 through a wireless communication channel according to communication protocols specified in respective communication standards. Please note that the invention is not limited by this.

[0013]In one example, the UE 110 and the base station 120 are configured to deploy carrier aggregation (CA) or dual-connection (DC) techniques to enhance UE's throughput.

[0014]When the system deploy the CA, it could have Master Cell Group(MCG) 130. The MCG 130 includes Pcell 131 and SCell 1 132 to SCell N 133.

[0015]When the system deploy the DC, it could have Master Cell Group(MCG) 130 and Secondary Cell Group(SCG) 140. The MCG 130 includes Pcell 131 and SCell 1 132 to SCell N 133. The SCG 140 includes PScell 141 and SCell 1 142 to SCell N 143.

[0016]Fig. 2 shows an example of first mmWave SCell activation procedure 200. When UE receives SCell activation command from BS MAC-CE, in step 210, UE will try to synchronize with the target SCell by AGC retuning, cell search, frequency/timing fine synchronization and MIB reading. After successful reading the MIB information, the SCell to be activated has been identified by UE. In step 220, UE will execute L1-RSRP beam management to search the fine Rx beam and/or Tx beam. It depends on BS's signaling. When UE finds the order of the Tx-Rx beam pairs by L1-RSRP beam management, UE will report the best N beam pairs to the BS by beam

reporting. In step 230, BS will decide the suitable beam pair for CSI reporting later when BS receives the beam reporting. After that, the BS will also decide the Transmission Configuration Indicator(TCI) for SCell's Channel State Information(CSI) reporting and spatial relation for SCell's SRS transmission. The BS signaling the TCI indication for CSI reporting, spatial relation for SRS transmission to UE. In step 240, the UE will process CSI reporting calculation based on the TCI indication signaling. After that, the UE will report the valid CSI reporting to BS. The SCell activation process is finished after BS successfully receive the valid CSI reporting by SCell.

[0017]Fig. 3 shows an example of first mmWave SCell activation procedure 300. In step 310, The UE will be asked to measure the deactivated SCell(s) based on the SS/PBCH blocks. The UE will report the measurement results with beam index for deactivated SCell(s). In step 320, BS will decide the suitable beam pair for CSI reporting later when BS receives the measurement reporting with beam index. After that, the BS will also decide the TCI for SCell's CSI reporting and spatial relation for SCell's SRS transmission. The BS signaling the TCI indication for CSI reporting, spatial relation for SRS transmission to UE. When UE receives SCell activation command from BS MAC-CE, in step 330, UE will try to synchronize with the target SCell by AGC retuning, cell search, frequency/timing fine synchronization and MIB reading. After successful reading the MIB information, the SCell to be activated has been identified by UE. In step 340, the UE will process CSI reporting calculation based on the TCI indication signaling. After that, the UE will report the valid CSI reporting to BS. The SCell activation process is finished after BS successfully receive the valid CSI reporting by SCell.

[0018]Fig. 4 shows an example of mmWave SCell activation procedure 400 except the first SCell activation. When UE receives SCell activation command from BS MAC-CE, in step 410, the UE could acquire the SCell to be activated TCI information by PCell or any activated serving cell in CA, or PSCell or any activated serving cell in DC scenario. In step 420, UE will try to synchronize with the target SCell by AGC retuning, cell search, frequency/timing fine synchronization and MIB reading. After successful reading the MIB information, the SCell to be activated has been identified by UE. In step 430, the UE will process CSI reporting calculation based on the TCI information and SRS transmission based on the spatial relation information from PCell /PSCell or any active serving cell. After that, the UE will report the valid CSI reporting to BS. The SCell activation process is finished after BS successfully receiving the valid CSI reporting by SCell.

[0019]Fig. 5 shows an exemplary block diagram of a UE 500 according to an embodiment of the disclosure. The UE 500 can be configured to implement various embodiments of the disclosure described herein. The UE 500 can include a processor 510, a memory 520, and a radio frequency (RF) module 1130 that are coupled together as shown in Fig. 5. In different examples, the UE 500 can be a mobile phone, a tablet computer, a desktop computer, a vehicle carried device, and the like.

[0020]The processor 510 can be configured to perform various functions of the UE 120 described above with reference to Figs. 1-4. The processor 510 can include signal processing circuitry to process received or to be transmitted data according to communication protocols specified in, for example, LTE and NR standards. Additionally, the processor 510 may execute program instructions, for example, stored in the memory 520, to perform functions related with different communication protocols. The processor 510 can be implemented with suitable hardware, software, or a combination thereof. For example, the processor 510 can be implemented with

application specific integrated circuits (ASIC), field programmable gate arrays (FPGA), and the like, that includes circuitry. The circuitry can be configured to perform various functions of the processor 510.

[0021]In one example, the memory 520 can store program instructions that, when executed by the processor 510, cause the processor 510 to perform various functions as described herein. The memory 520 can include a read only memory (ROM), a random access memory (RAM), a flash memory, a solid state memory, a hard disk drive, and the like.

[0022]The RF module 530 can be configured to receive a digital signal from the processor 510 and accordingly transmit a signal to a base station in a wireless communication network via an antenna 540. In addition, the RF module 530 can be configured to receive a wireless signal from a base station and accordingly generate a digital signal which is provided to the processor 510. The RF module 530 can include digital to analog/analog to digital converters (DAC/ADC), frequency down/up converters, filters, and amplifiers for reception and transmission operations. For example, the RF module 530 can include converter circuits, filter circuits, amplification circuits, and the like, for processing signals on different carriers or bandwidth parts.

[0023]The UE 500 can optionally include other components, such as input and output devices, additional CPU or signal processing circuitry, and the like. Accordingly, the UE 500 may be capable of performing other additional functions, such as executing application programs, and processing alternative communication protocols.

[0024]The processes and functions described herein can be implemented as a computer program which, when executed by one or more processors, can cause the one or more processors to perform the respective processes and functions. The computer program may be stored or distributed on a suitable medium, such as an optical storage medium or a solid-state medium supplied together with, or as part of, other hardware. The computer program may also be distributed in other forms, such as via the Internet or other wired or wireless telecommunication systems. For example, the computer program can be obtained and loaded into an apparatus, including obtaining the computer program through physical medium or distributed system, including, for example, from a server connected to the Internet.

[0025]The computer program may be accessible from a computer-readable medium providing program instructions for use by or in connection with a computer or any instruction execution system. A computer readable medium may include any apparatus that stores, communicates, propagates, or transports the computer program for use by or in connection with an instruction execution system, apparatus, or device. The computer-readable medium can be magnetic, optical, electronic, electromagnetic, infrared, or semiconductor system (or apparatus or device) or a propagation medium. The computer-readable medium may include a computer-readable non-transitory storage medium such as a semiconductor or solid state memory, magnetic tape, a removable computer diskette, a random access memory (RAM), a read-only memory (ROM), a magnetic disk and an optical disk, and the like. The computer-readable non-transitory storage medium can include all types of computer readable medium, including magnetic storage medium, optical storage medium, flash medium and solid state storage medium.

[0026]While aspects of the present disclosure have been described in conjunction with the specific embodiments thereof that are proposed as examples, alternatives, modifications, and variations to the examples may be made. Accordingly, embodiments as set forth herein are intended to be illustrative and not limiting. There are

changes that may be made without departing from the scope of the claims set forth below.

CLAIMS

1.A method, comprising:

SCell identification process, L1-RSRP beam management and reporting, and CSI reporting in UE side; and beam selection and TCI and spatial relation indication signaling in BS side.

2.The method of claim 1, further comprising:

the SCell to be activated is the first mmWave cell for UE.

3.The method of claim 1, further comprising:

the beam management in SCell to be activated should measure and acquire the best M(M>=1) beam pair between Tx and Rx.

4.The method of claim 1, further comprising:

the beam reporting in SCell to be activated should report the best N(N>=1, N<=M) beam pair to BS.

5.A method, comprising:

deactivated SCell measurement and reporting, SCell identification process, and CSI reporting in UE side; and SSB-based beam selection and TCI and spatial relation indication signaling in BS side.

6.The method of claim 5, further comprising:

The SCell to be activated is the first mmWave cell for UE.

7.The method of claim 5, further comprising:

the deactivated SCell measurement reporting should include beam index.

8.A method, comprising:

acquire SCell TCI information by PCell and PSCell, SCell identification process, and CSI reporting in UE side.

9.The method of claim 8, further comprising:

the SCell to be activated is not the first mmWave cell for UE.

10.The method of claim 8, further comprising:

the SCell to be activated TCI and spatial relation indication could be acquired by PCell/PSCell or other activated serving cells.

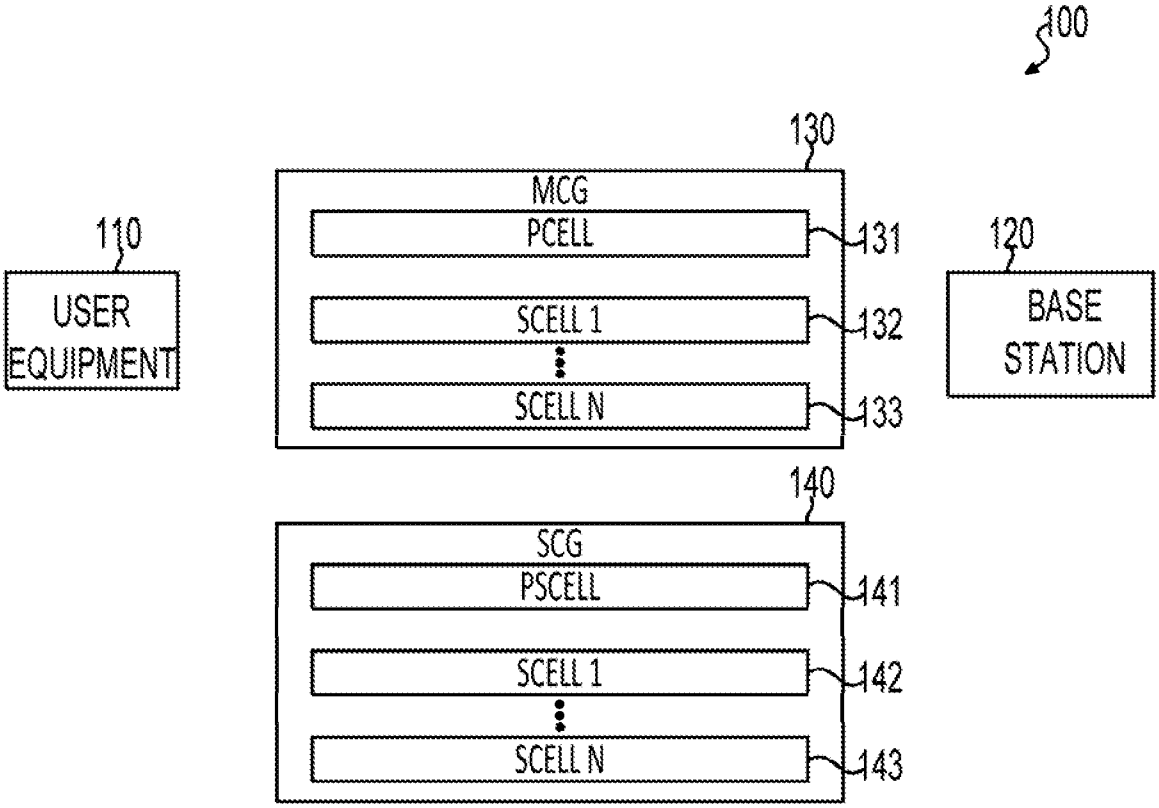
100
130
MCG
PCELL
131
SCELL 1
132
SCELL N
133
110
USER EQUIPMENT
120
BASE STATION
140
SCG
PSCELL
141
SCELL 1
142
SCELL N
143

FIG. 1

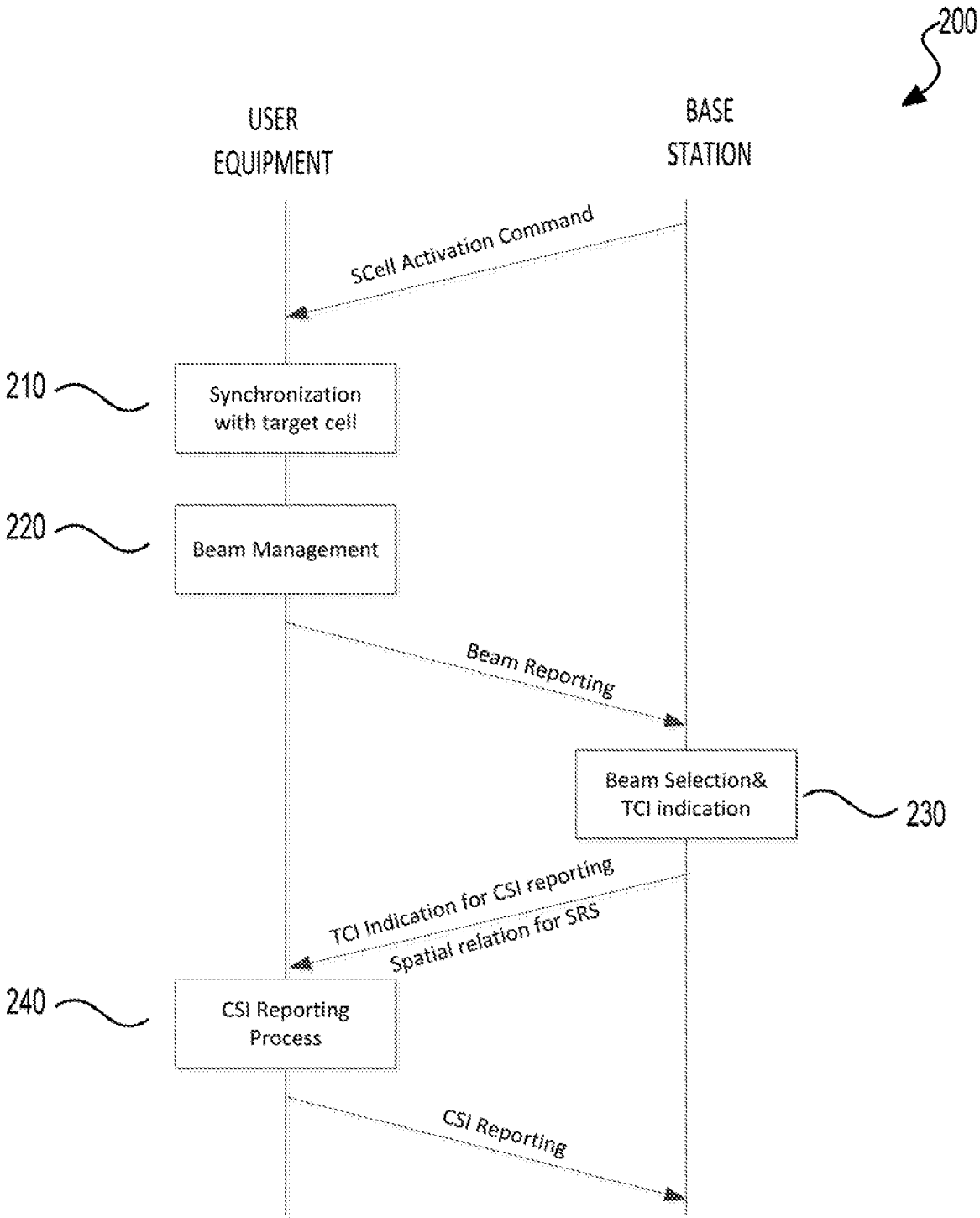
200
USER EQUIPMENT
BASE STATION
SCell Activation Command
210
Synchronization with target cell
220
Beam Management
Beam Reporting
Beam Selection& TCI indication
230
TCI indication for CSI reporting
Spatial relation for SRS
240
CSI Reporting Process
CSI Reporting

FIG. 2

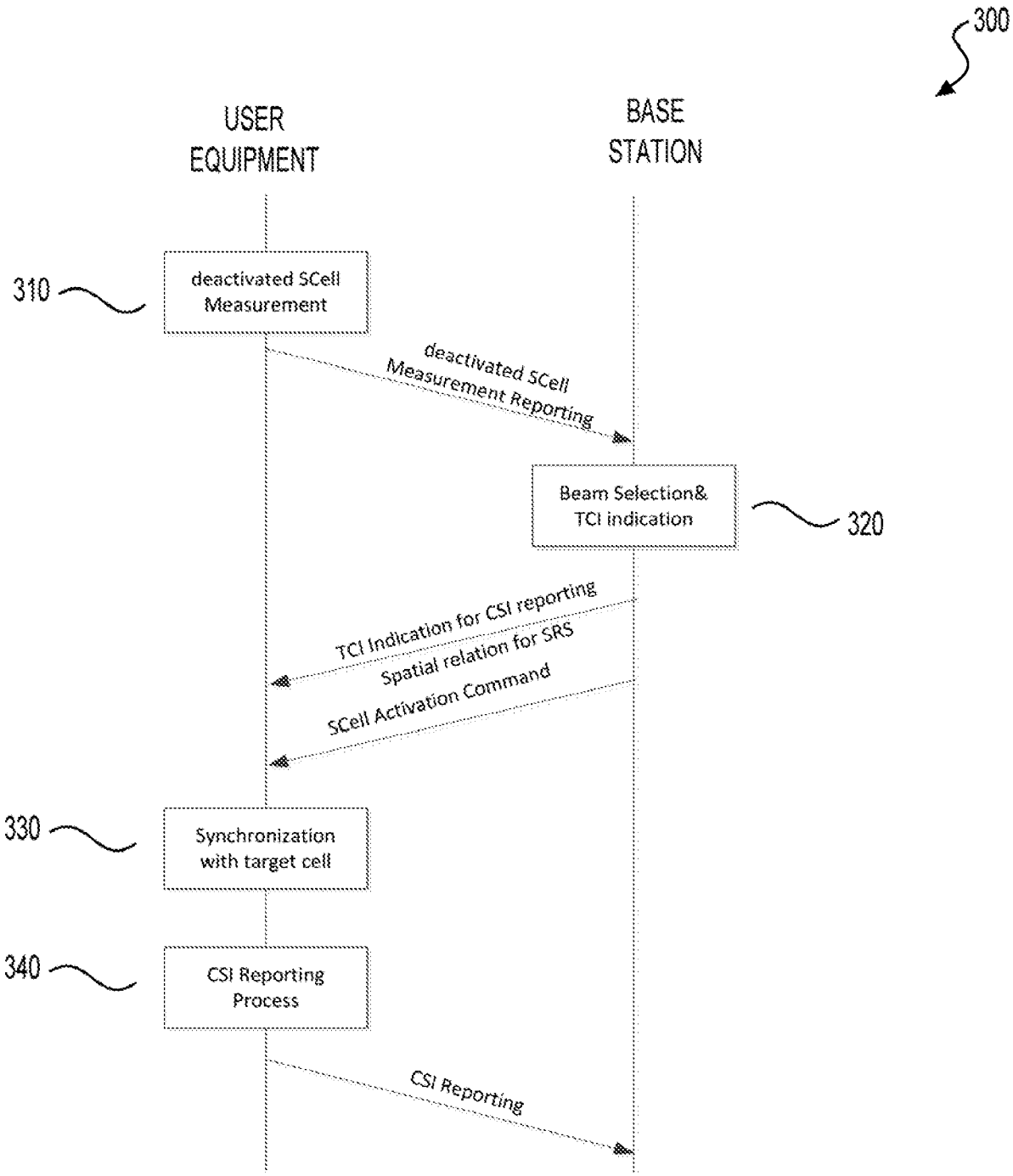
300
USER EQUIPMENT
BASE STATION
310
deactivated SCell Measurement
deactivated SCell Measurement Reporting
Beam Selection& TCI indication
320
TCI Indication for CSI reporting
Spatial relation for SRS
SCell Activation Command
330
Synchronization with target cell
340
CSI Reporting Process
CSI Reporting

FIG. 3

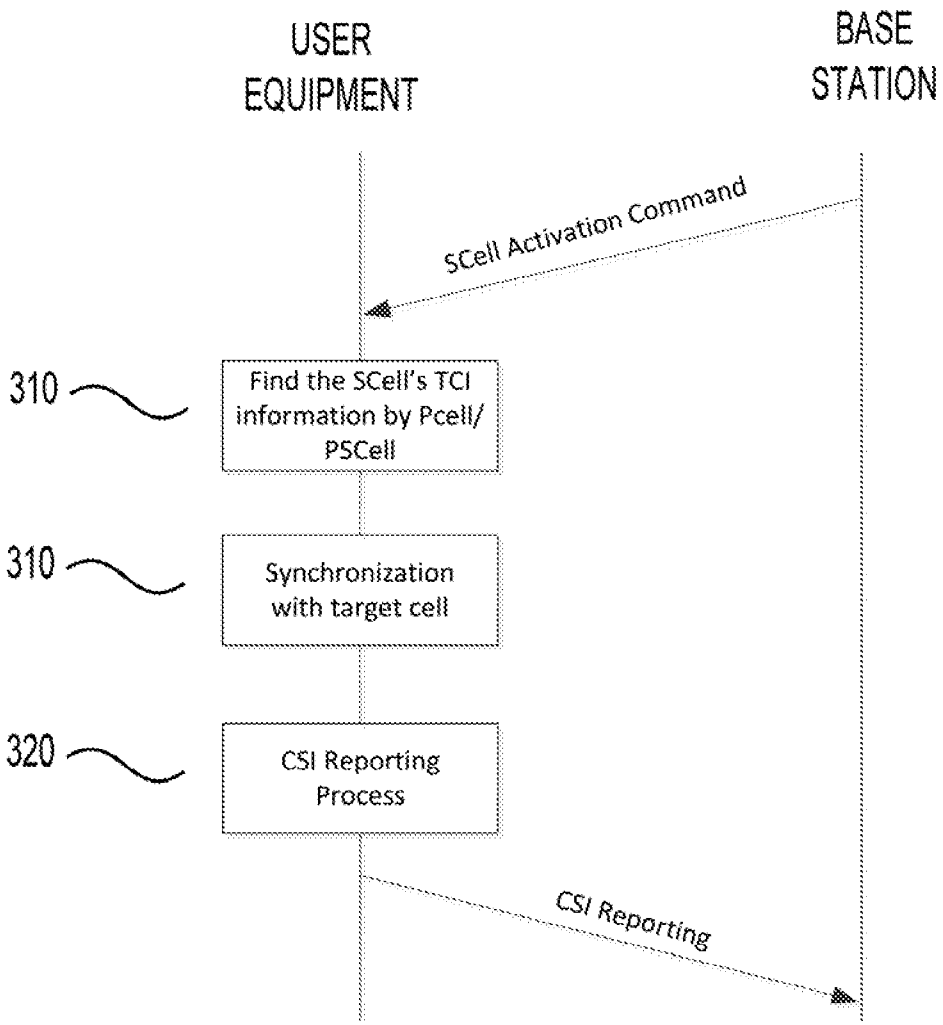
USER EQUIPMENT
BASE STATION
SCell Activation Command
310
Find the SCell's TCI information by Pcell/ PSCell
310
Synchronization with target cell
320
CSI Reporting Process
CSI Reporting

FIG. 4

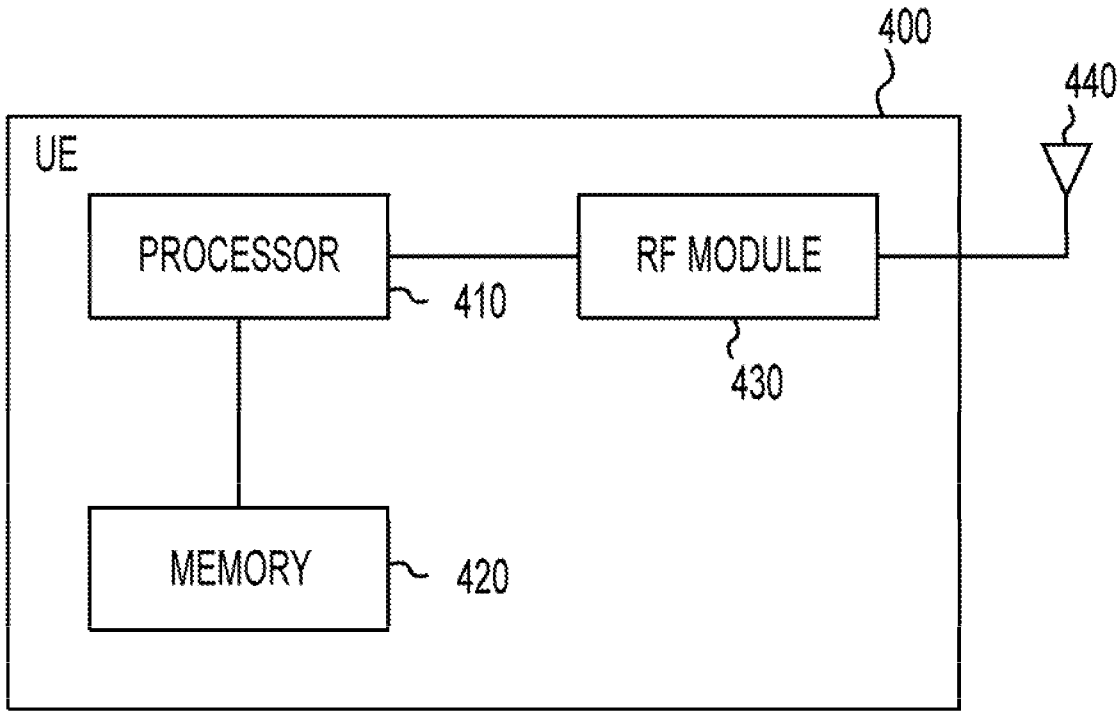

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2019/075231

A. CLASSIFICATION OF SUBJECT MATTER

H04W 72/00(2009.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS,CNTXT,CNKI,VEN,USTXT: activat+,deactivat+,SCell/secondary cell, Pcell/primary cell,identification,beam, management/select+,report,CSI/channel state information,TCI/transmission configuration indicator,spatial,BS/base station,UE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2019029330 A1 (HUAWEI TECHNOLOGIES CO., LTD.) 14 February 2019 (2019-02-14) claims 1-10	1-10
Y	CN 107889256 A (BEIJING XINWEI TELECOMMUNICATION TECHNOLOGY CO., LTD.) 06 April 2018 (2018-04-06) claims 1-18	1-10
A	US 2018131431 A1 (OFINNO TECHNOLOGIES, LLC) 10 May 2018 (2018-05-10) the whole document	1-10
A	US 9888474 B2 (SAMSUNG ELECTRONICS CO., LTD.) 06 February 2018 (2018-02-06) the whole document	1-10

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 October 2019	**18 November 2019**
Name and mailing address of the ISA/CN **National Intellectual Property Administration, PRC** **6, Xitucheng Rd., Jimen Bridge, Haidian District, Beijing 100088** **China** Facsimile No. **(86-10)62019451**	Authorized officer **ZHANG,Yanqing** Telephone No. **86-（010）-62088429**

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2019/075231

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
WO 2019029330 A1	14 February 2019	CN 109391986 A	26 February 2019
CN 107889256 A	06 April 2018	None	
US 2018131431 A1	10 May 2018	US 10218425 B2	26 February 2019
US 9888474 B2	06 February 2018	US 2016255634 A1	01 September 2016