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(54) Title: MANAGING CARRIER AGGREGATION CONFIGURATION FOR LOWER LAYER TRIGGERED MOBILITY

(57) Abstract: A distributed unit (DU) of a distributed base station receives, from a central unit (CU) of the distributed base station, a CU-to-DU message including a request to prepare a low- lower layer mobility (LTM) DU configuration for a user equipment (UE), the request including a special cell (SpCell) identity (ID) and a secondary cell (SCell) ID (902). The DU generates the LTM DU configuration for an SpCell corresponding to the SPCell ID and an SCell corresponding to the SCell ID (904A) and transmits the LTM DU configuration to the CU (906A).

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MANAGING CARRIER AGGREGATION CONFIGURATION FOR LOWER LAYER TRIGGERED MOBILITY

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to and the benefit of the filing date of provisional U.S. Patent Application No. 63/485,525, titled “Managing Carrier Aggregation Configuration for Lower Layer Triggered Mobility,” filed on February 16, 2023. The entire contents of the provisional application are hereby expressly incorporated herein by reference.

FIELD OF THE DISCLOSURE

[0002] This disclosure relates to wireless communications and, more particularly, to managing carrier aggregation for a lower layer triggered mobility, i.e., a fast serving cell change, for a user equipment (UE).

BACKGROUND

[0003] This background description is provided for the purpose of generally presenting the context of the disclosure. Work of the presently named inventors, to the extent it 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.

[0004] In telecommunication systems, the Packet Data Convergence Protocol (PDCP) sublayer of the radio protocol stack provides services such as transfer of user-plane data, ciphering, integrity protection, etc. For example, the PDCP layer defined for the Evolved Universal Terrestrial Radio Access (EUTRA) radio interface (see 3GPP specification TS 36.323) and New Radio (NR) (see 3GPP specification TS 38.323) provides sequencing of protocol data units (PDUs) in the uplink direction (from a user device, also known as a user equipment (UE), to a base station) as well as in the downlink direction (from the base station to the UE). Further, the PDCP sublayer provides signaling radio bearers (SRBs) and data radio bearers (DRBs) to the Radio Resource Control (RRC) sublayer. Generally speaking, the UE and a base station can use SRBs to exchange RRC messages as well as non-access stratum (NAS) messages, and can use DRBs to transport data on a user plane.

[0005] UEs can use several types of SRBs and DRBs. When operating in dual connectivity (DC), the cells associated with the base station operating the master node (MN) define a master cell group (MCG), and the cells associated with the base station operating as

the secondary node (SN) define the secondary cell group (SCG). So-called SRB1 resources carry RRC messages, which in some cases include NAS messages over the dedicated control channel (DCCH), and SRB2 resources support RRC messages that include logged measurement information or NAS messages, also over the DCCH but with lower priority than SRB1 resources. More generally, SRB1 and SRB2 resources allow the UE and the MN to exchange RRC messages related to the MN and embed RRC messages related to the SN, and also can be referred to as MCG SRBs. SRB3 resources allow the UE and the SN to exchange RRC messages related to the SN, and can be referred to as SCG SRBs. Split SRBs allow the UE to exchange RRC messages directly with the MN via lower layer resources of the MN and the SN. Further, DRBs using the lower-layer resources of only the MN can be referred as MCG DRBs, DRBs using the lower-layer resources of only the SN can be referred as SCG DRBs, and DRBs using the lower-layer resources of both the MCG and the SCG can be referred to as split DRBs.

[0006] The UE in some scenarios can concurrently utilize resources of multiple radio access network (RAN) nodes (e.g., base stations or components of a distributed base station), interconnected by a backhaul. When these network nodes support different radio access technologies (RATs), this type of connectivity is referred to as Multi-Radio Dual Connectivity (MR-DC). When a UE operates in MR-DC, one base station operates as a master node (MN) that covers a primary cell (PCell), and the other base station operates as a secondary node (SN) that covers a primary secondary cell (PSCell). The UE communicates with the MN (via the PCell) and the SN (via the PSCell). In other scenarios, the UE utilizes resources of one base station at a time. One base station and/or the UE determines that the UE should establish a radio connection with another base station. For example, one base station can determine to hand the UE over to the second base station, and initiate a handover procedure.

[0007] When the UE moves from coverage area of one cell to another cell in a RAN, at some point a serving cell change has to be performed for the UE. To perform the serving cell change, the RAN configures the UE to transmit Layer 3 (L3) measurement results. Based on L3 measurement results received from the UE, the RAN transmits a RRC reconfiguration message configuring Reconfiguration with Synchronization (e.g., the RRC reconfiguration message includes a *ReconfigurationWithSync* IE) for change of the serving cell (e.g., PCell or PSCell). In cases where the UE operates in carrier aggregation (CA) of at least one secondary cell (SCell) with the PCell or PSCell, the RAN has to release the at least one SCell

due to the change of the PCell or PSCell. The serving cell change involves complete L2 (and L1) resets, leading to longer latency, larger overhead and longer interruption time. Thus, 3GPP recently kicks off a new work item described in RP-221799 to develop new mobility techniques to reduce latency and overhead for fast serving cell change.

[0008] However, it is not clear how devices should manage a serving cell change using a lower layer signaling, i.e., lower layer mobility (LTM) functionality a base station of the RAN. Especially, it is not clear how to configure carrier aggregation for LTM.

SUMMARY

[0009] An example embodiment of these techniques is a method in a distributed unit (DU) of a distributed base station. The method includes receiving, from a central unit (CU) of the distributed base station, a CU-to-DU message including a request to prepare a low-layer mobility (LTM) DU configuration for a user equipment (UE), the request including a special cell (SpCell) identity (ID) and a secondary cell (SCell) ID; generating the LTM DU configuration for an SpCell corresponding to the SPCell ID and an SCell corresponding to the SCell ID; and transmitting the LTM DU configuration to the CU.

[0010] Another example embodiment of these techniques is a radio access network (RAN) node comprising a transceiver and processing hardware, the RAN configured to implement the method above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Fig. 1A is a block diagram of an example system in which a radio access network (RAN) and a user device can implement the techniques of this disclosure for managing conditional procedures related to a secondary node (SN);

[0012] Fig. 1B is a block diagram of an example base station including a centralized unit (CU) and a distributed unit (DU) that can operate in the system of Fig. 1A;

[0013] Fig. 2A is a block diagram of an example protocol stack according to which the UE of Fig. 1A communicates with base stations;

[0014] Fig. 2B is a block diagram of an example protocol stack according to which the UE of Fig. 1A communicates with a CU and a DU; and

[0015] Fig. 3 is a messaging diagram of an example scenario in which a UE performs an LTM switch from a serving cell of a DU to a candidate cell of the same DU;

[0016] Fig. 4 is a messaging diagram of an example scenario in which a UE performs an LTM switch from a serving cell of a source DU to a candidate cell of a target DU;

[0017] Figs. 5A-B are messaging diagrams of example scenarios in which a UE operates in dual connectivity with an MN and an SN, and performs an LTM switch from a serving cell of a DU of the SN to a candidate cell of the same DU of the SN;

[0018] Figs. 6A-B are messaging diagrams of example scenarios in which a UE operates in dual connectivity with an MN and an SN, and performs an LTM switch from a serving cell of a source DU of the SN to a candidate cell of the target DU of the SN;

[0019] Fig. 7A-B are messaging diagrams of scenarios similar to those of Figs. 5A-B, but where the MN and the SN are implemented in different DUs of the same distributed base station;

[0020] Fig. 8A-B are messaging diagrams of scenarios similar to those of Figs. 6A-B, but where the MN and the SN are implemented in different DUs of the same distributed base station;

[0021] Figs. 9A-10G are example methods in a DU for selectively configuring a UE with an LTM configuration that includes a primary cell and a secondary cell, determining whether the LTM configuration should include both cells, and determining when the UE operates in carrier aggregation following an LTM serving cell switch, in view of various factors or signals; and

[0022] Fig. 11A-C are example methods in a CU for selectively configuring a UE with an LTM configuration that includes a primary cell and a secondary cell.

DETAILED DESCRIPTION OF THE DRAWINGS

[0023] Fig. 1A depicts an example wireless communication system 100 in which communication devices can implement these techniques. The wireless communication system 100 includes a UE 102, a base station (BS) 104, a base station 106 and a core network (CN) 110. The UE 102 initially connects to the base station 104. In some scenarios, the base station 104 can perform an SN addition to configure the UE 102 to operate in dual connectivity (DC) with the base station 104 and the base station 106. The base stations 104 and 106 operate as an MN and an SN for the UE 102, respectively.

[0024] In various configurations of the wireless communication system 100, the base station 104 can be implemented as a master eNB (MeNB) or a master gNB (MgNB), and the base station 106 can be implemented as a secondary gNB (SgNB). The UE 102 can communicate with the base station 104 and the base station 106 via the same RAT such as EUTRA or NR, or different RATs. When the base station 104 is an MeNB and the base station 106 is a SgNB, the UE 102 can be in EUTRA-NR DC (EN-DC) with the MeNB and the SgNB.

[0025] In some cases, an MeNB or an SeNB is implemented as an ng-eNB rather than an eNB. When the base station 104 is a Master ng-eNB (Mng-eNB) and the base station 106 is a SgNB, the UE 102 can be in next generation (NG) EUTRA-NR DC (NGEN-DC) with the Mng-eNB and the SgNB. When the base station 104 is an MgNB and the base station 106 is an SgNB, the UE 102 may be in NR-NR DC (NR-DC) with the MgNB and the SgNB. When the base station 104 is an MgNB and the base station 106 is a Secondary ng-eNB (Sng-eNB), the UE 102 may be in NR-EUTRA DC (NE-DC) with the MgNB and the Sng-eNB.

[0026] In the scenarios where the UE 102 hands over from the base station 104 to the base station 106, the base stations 104 and 106 operate as the source base station (S-BS) and a target base station (T-BS), respectively. The UE 102 can operate in DC with the base station 104 and an additional base station (not shown in Fig. 1A) for example prior to the handover. The UE 102 can continue to operate in DC with the base station 106 and the additional base station or operate in single connectivity (SC) with the base station 106, after completing the handover. The base stations 104 and 106 in this case operate as a source MN (S-MN) and a target MN (T-MN), respectively.

[0027] A core network (CN) 110 can be an evolved packet core (EPC) 111 or a fifth-generation core (5GC) 160, both of which are depicted in Fig. 1A. The base station 104 can be an eNB supporting an S1 interface for communicating with the EPC 111, an ng-eNB supporting an NG interface for communicating with the 5GC 160, or a gNB that supports an NR radio interface as well as an NG interface for communicating with the 5GC 160. To directly exchange messages with each other during the scenarios discussed below, the base stations 104 and 106 can support an X2 or Xn interface. Among other components, the EPC 111 can include a Serving Gateway (SGW) 112, a Mobility Management Entity (MME) 114, and a Packet Data Network Gateway (PGW) 116. The SGW 112 is generally configured to transfer user-plane packets related to audio calls, video calls, Internet traffic, etc., and the

MME 114 is configured to manage authentication, registration, paging, and other related functions. The PGW 116 provides connectivity from the UE to one or more external packet data networks, e.g., an Internet network and/or an Internet Protocol (IP) Multimedia Subsystem (IMS) network. The 5GC 160 includes a User Plane Function (UPF) 162 and an Access and Mobility Management (AMF) 164, and/or Session Management Function (SMF) 166. The UPF 162 is generally configured to transfer user-plane packets related to audio calls, video calls, Internet traffic, etc., the AMF 164 is configured to manage authentication, registration, paging, and other related functions, and the SMF 166 is configured to manage PDU sessions.

[0028] As illustrated in Fig. 1A, the base station 104 supports cell 124A, and the base station 106 supports a cell 126. The cells 124A and 126 can partially overlap, so that the UE 102 can communicate in DC with the base station 104 and the base station 106, where one of the base stations 104 and 106 is an MN and the other is an SN. The base station 104 can support additional cell(s) such as cells 124B and 124C, and the base station 106 can support additional cell(s) (not shown in Fig. 1A). The cells 124A, 124B and 124C can partially overlap, so that the UE 102 can communicate in carrier aggregation (CA) with the base station 104. The base station 104 can operate the cells 124A, 124B and 124C via one or more transmit and receive points (TRPs). More particularly, when the UE 102 is in DC with the base station 104 and the base station 106, one of the base stations 104 and 106 operates as an MeNB, an Mng-eNB or an MgNB, and the other operates as an SgNB or an Sng-eNB.

[0029] In general, the wireless communication network 100 can include any suitable number of base stations supporting NR cells and/or EUTRA cells. More particularly, the EPC 111 or the 5GC 160 can be connected to any suitable number of base stations supporting NR cells and/or EUTRA cells. Although the examples below refer specifically to specific CN types (EPC, 5GC) and RAT types (5G NR and EUTRA), in general the techniques of this disclosure also can apply to other suitable radio access and/or core network technologies such as sixth generation (6G) radio access and/or 6G core network or 5G NR-6G DC.

[0030] With continued reference to Fig. 1A, the base station 104 is equipped with processing hardware 130 that can include one or more general-purpose processors (e.g., CPUs) and a non-transitory computer-readable memory storing instructions that the one or more general-purpose processors execute. Additionally or alternatively, the processing hardware 130 can include special-purpose processing units. The processing hardware 130

can include a PHY controller 132 configured to transmit data and control signal on physical downlink (DL) channels and DL reference signals with one or more user devices (e.g. UE 102) via one or more cells (e.g., the cell(s) 124A, 124B and/or 124C) and/or one or more TRPs. The PHY controller 132 is also configured to receive data and control signal on physical uplink (UL) channels and/or UL reference signals with the one or more user devices via one or more cells (e.g., the cell(s) 124A, 124B and/or 124C) and/or one or more TRPs. The processing hardware 130 in an example implementation includes a MAC controller 134 configured to perform MAC functions with one or more user devices. The MAC functions includes a random access (RA) procedure, managing UL timing advance for the one or more user devices, and/or communicating UL/DL MAC PDUs with the one or more user devices. The processing hardware 130 can further include an RRC controller 136 to implement procedures and messaging at the RRC sublayer of the protocol communication stack. For example, the RRC controller 132 may be configured to support RRC messaging associated with handover procedures, and/or to support the necessary operations when the base station 104 operates as an MN relative to an SN or as an SN relative to an MN. The base station 106 can include processing hardware 140 that is similar to processing hardware 130. In particular, components 142, 144, and 146 can be similar to the components 132, 134, and 136, respectively.

[0031] The UE 102 is equipped with processing hardware 150 that can include one or more general-purpose processors such as CPUs and non-transitory computer-readable memory storing machine-readable instructions executable on the one or more general-purpose processors, and/or special-purpose processing units. The PHY controller 152 is also configured to receive data and control signal on physical DL channels and/or DL reference signals with the base station 104 or 106 via one or more cells (e.g., the cell(s) 124A, 124B, 124C and/or 126) and/or one or more TRPs. The PHY controller 152 is also configured to transmit data and control signal on physical UL channels and/or UL reference signals with the base station 104 or 106 via one or more cells (e.g., the cell(s) 124A, 124B, 124C and/or 126) and/or one or more TRPs. The processing hardware 150 in an example implementation includes a MAC controller 154 configured to perform MAC functions with base station 104 or 106. For example, the MAC functions includes a random access procedure, managing UL timing advance for the one or more user devices, and communicating UL/DL MAC PDUs with the base station 104 or 106. The processing hardware 150 can further include an RRC

controller 156 to implement procedures and messaging at the RRC sublayer of the protocol communication stack.

[0032] In operation, the UE 102 in DC can use a radio bearer (e.g., a DRB or an SRB) that at different times terminates at the MN 104 or the SN 106. The UE 102 can apply one or more security keys when communicating on the radio bearer, in the uplink (UL) (from the UE 102 to a base station) and/or downlink (from a base station to the UE 102) direction.

[0033] Fig. 1B depicts an example distributed implementation of a base station such as the base station 104 or 106. The base station in this implementation can include a centralized unit (CU) 172 and one or more distributed units (DUs) 174. The CU 172 is equipped with processing hardware that can include one or more general-purpose processors such as CPUs and non-transitory computer-readable memory storing machine-readable instructions executable on the one or more general-purpose processors, and/or special-purpose processing units. In one example, the CU 172 is equipped with the processing hardware 130. In another example, the CU 172 is equipped with the processing hardware 140. The processing hardware 140 in an example implementation includes an SN RRC controller 142 configured to manage or control one or more RRC configurations and/or RRC procedures when the base station 106 operates as an SN. The DU 174 is also equipped with processing hardware that can include one or more general-purpose processors such as CPUs and non-transitory computer-readable memory storing machine-readable instructions executable on the one or more general-purpose processors, and/or special-purpose processing units. In some examples, the processing hardware in an example implementation includes a medium access control (MAC) controller configured to manage or control one or more MAC operations or procedures (e.g., a random access procedure) and a radio link control (RLC) controller configured to manage or control one or more RLC operations or procedures when the base station 106 operates as an MN or an SN. The process hardware may include further a physical layer controller configured to manage or control one or more physical layer operations or procedures.

[0034] Fig. 2A illustrates, in a simplified manner, an example protocol stack 200 according to which the UE 102 can communicate with an eNB/ng-eNB or a gNB (e.g., one or more of the base stations 104, 106).

[0035] In the example stack 200, a physical layer (PHY) 202A of EUTRA provides transport channels to the EUTRA MAC sublayer 204A, which in turn provides logical

channels to the EUTRA RLC sublayer 206A. The EUTRA RLC sublayer 206A in turn provides RLC channels to an EUTRA PDCP sublayer 208 and, in some cases, to an NR PDCP sublayer 210. Similarly, the NR PHY 202B provides transport channels to the NR MAC sublayer 204B, which in turn provides logical channels to the NR RLC sublayer 206B. The NR RLC sublayer 206B in turn provides data transfer services to the NR PDCP sublayer 210. The NR PDCP sublayer 210 in turn can provide data transfer services to Service Data Adaptation Protocol (SDAP) 212 or a radio resource control (RRC) sublayer (not shown in Fig. 2A). The UE 102, in some implementations, supports both the EUTRA and the NR stack as shown in Fig. 2A, to support handover between EUTRA and NR base stations and/or to support DC over EUTRA and NR interfaces. Further, as illustrated in Fig. 2A, the UE 102 can support layering of NR PDCP 210 over EUTRA RLC 206A, and SDAP sublayer 212 over the NR PDCP sublayer 210.

[0036] The EUTRA PDCP sublayer 208 and the NR PDCP sublayer 210 receive packets (e.g., from an Internet Protocol (IP) layer, layered directly or indirectly over the PDCP layer 208 or 210) that can be referred to as service data units (SDUs), and output packets (e.g., to the RLC layer 206A or 206B) that can be referred to as protocol data units (PDUs). Except where the difference between SDUs and PDUs is relevant, this disclosure for simplicity refers to both SDUs and PDUs as “packets.”

[0037] On a control plane, the EUTRA PDCP sublayer 208 and the NR PDCP sublayer 210 can provide signaling radio bearers (SRBs) or RRC sublayer (not shown in Fig. 2A) to exchange RRC messages or non-access-stratum (NAS) messages, for example. On a user plane, the EUTRA PDCP sublayer 208 and the NR PDCP sublayer 210 can provide Data Radio Bearers (DRBs) to support data exchange. Data exchanged on the NR PDCP sublayer 210 can be SDAP PDUs, Internet Protocol (IP) packets or Ethernet packets.

[0038] Fig. 2B illustrates, in a simplified manner, an example protocol stack 250, which the UE 102 can communicate with a DU (e.g., DU 174) and a CU (e.g., CU 172). The radio protocol stack 200 is functionally split as shown by the radio protocol stack 250 in Fig. 2B. The CU at any of the base stations 104 or 106 can hold all the control and upper layer functionalities (e.g., RRC 214, SDAP 212, NR PDCP 210), while the lower layer operations (e.g., NR RLC 206B, NR MAC 204B, and NR PHY 202B) are delegated to the DU. To support connection to a 5GC, NR PDCP 210 provides SRBs to RRC 214, and NR PDCP 210 provides DRBs to SDAP 212 and SRBs to RRC 214.

[0039] Next, several example scenarios in which the base station operating in the system of Fig. 1A transmits a configuration to the UE 102 and later activates a configuration for communication between the UE 102 and base station. Generally speaking, events in Figs. 3-7B that are similar are labeled with similar reference numbers (*e.g.*, event 316 is similar to event 416 of Figs 4A and 4B, event 516 of Fig. 5A, event 517 of Fig. 5B, event 616 of Fig. 6A, event 617 of Fig. 6B, event 716 of Fig. 7A, and event 717 of Fig. 7B), with differences discussed below where appropriate. With the exception of the differences shown in the figures and discussed below, any of the alternative implementations discussed with respect to a particular event (*e.g.*, for messaging and processing) may apply to events labeled with similar reference numbers in other figures.

[0040] Referring first to Fig. 3, in a scenario 300, the base station 104 includes a CU 172 and a DU 174 and the DU 174 operates the cell 124A. The UE 102 initially communicates 302 with the DU 174 on the cell 124A using a serving DU configuration, and communicates with the CU 172 via the DU 174, *e.g.*, using a serving CU configuration. In some implementations, the UE 102 in carrier aggregation (CA) communicates with the DU 174 on the cell 124A and other cell(s) (*e.g.*, cell 124D not shown in Fig. 1A) using the serving DU configuration. The DU 174 operates the other cell(s). In other implementations, the UE 102 in communicates with the DU 174 on the cell 124A only. In some implementations, the UE 102 communicates with the DU 174 on the cell 124A and/or other cell(s) via one or multiple TRPs. In some implementations, the cell 124A can be a PCell. In such cases, the other cell(s) include SCell(s) and/or additional cell(s) associated with the PCell or a SCell. In other implementations, the cell 124A can be a SCell, and one of the other cell(s) is a PCell. In such cases, the rest includes SCell(s) and/or additional cell(s) associated with the PCell or a SCell. In the following description, the base station 104 can be the DU 174, the CU 172 or the DU 174 and CU 172.

[0041] In the event 302, the UE 102 can transmit UL PDUs and/or UL control signals to the base station 104 on the cell 124A and/or other cell(s) via one or multiple TRPs. In some implementations, the UE 102 communicates UL PDUs and/or DL PDUs with the base station 104 via radio bearers which can include SRBs and/or DRB(s). The base station 104 can configure the radio bearers to the UE 102. In some implementations, UL control signals include UL control information, channel state information, hybrid automatic repeat request (HARQ) acknowledgements (ACKs), HARQ negative ACKs, scheduling request(s) and/or sounding reference signal(s). Similarly, the UE 102 can receive DL PDUs and/or DL control

signals from the base station 104 on the cell 124A and/or other cell(s) via one or multiple TRPs. In some implementations, the DL control signals include downlink control information (DCIs) and reference signals (e.g., synchronization signal block, channel state information reference signal(s) (CSI-RS(s)), and/or tracking reference signal(s)). The base station 104 can transmit the DCIs on physical downlink control channel(s) (PDCCH(s)) monitored by the UE 102, on the cell 124A and/or other cell(s) via one or multiple TRPs.

[0042] In some implementations, the serving DU configuration includes physical layer configuration parameters, MAC configuration parameters, and/or RLC configuration parameters. In some implementations, the DU 174 can transmit these configuration parameters to the CU 172. The CU 172 generates one or more messages (e.g., RRC reconfiguration message(s)) including the configuration parameters and transmits the one or more messages to the UE 102 via the DU 174. In other implementations, the DU 174 transmits the configuration parameters to the UE 102 directly. In some implementations, the serving DU configuration is *CellGroupConfig* IE defined in 3GPP specification 38.331. In other implementations, the serving DU configuration includes configuration parameters in the *CellGroupConfig* IE. In some implementations, the serving CU configuration includes PDCP configuration parameters, measurement configuration parameters, and/or radio bearer configuration parameters. In some implementations, the serving CU configuration includes a *MeasConfig* IE and/or a *RadioBearerConfig* IE defined in 3GPP specification 38.331 or includes configuration parameters in the *MeasConfig* IE and/or *RadioBearerConfig* IE. In some implementations, the serving DU configuration includes a *CSI-MeasConfig* IE or configuration parameters for channel state information (CSI) measurement and reporting. In other implementations, the serving CU configuration includes a *CSI-MeasConfig* IE or configuration parameters for channel state information (CSI) measurement and reporting. In some implementations, the UE 102 receives the serving CU configuration or the configuration parameters in the serving CU configuration from the CU 172 via the DU 174. In other implementations, the UE 102 receives a portion of the serving CU configuration and/or a portion of the serving DU configuration from a base station other than the base station 104 and the remaining portion of these configuration parameters from the base station 104.

[0043] While communicating with the base station 104, the UE 102 transmits 304 at least one measurement report to the DU 174. In some implementations, the at least one measurement report includes Layer 1 (L1) measurement report(s) and/or Layer 3 (L3)

measurement report(s) for at least one serving cell of the UE 102 and/or at least one non-serving cell. For each of the L3 measurement report(s), the DU 174 transmits 306 a DU-to-CU message including the L3 measurement report to the CU 172. In some implementations, the DU-to-CU message(s) of the event 306 is/are F1 application protocol (F1AP) message(s) (e.g., *UL RRC Message Transfer* message(s)). In some implementations, the DU 174 does not transmit or refrains from transmitting the L1 measurement report(s) to the CU 172. The at least one serving cell includes the cell 124A and/or other cell(s), and the at least one non-serving cell includes the cell 124B and/or cell 124C. In some implementations, the serving DU configuration or the serving CU configuration includes at least one measurement configuration. In some implementations, the UE 102 receives one or more RRC messages (e.g., *RRCReconfiguration* message(s)) including the at least one measurement configuration from the CU 172 via the DU 174 in the event 302. In accordance with the at least one measurement configuration, the UE 102 performs measurements and transmits 304 the at least one measurement report to the DU 174. In some implementations, the at least one measurement configuration includes L3 measurement configuration(s) (e.g., *MeasConfig* IE(s)) and/or L1 measurement configuration(s). The L1 measurement configuration(s) (e.g., *CSI-MeasConfig* IE(s)) can include L1 measurement resource configuration(s) and/or L1 measurement reporting configuration(s). The L1 measurement resource configuration(s) can configure resources of reference signal(s) (e.g., CSI-RS(s)) for the UE 102 to measure and obtain L1 measurement results. For example, the L1 measurement resource configuration(s) is/are *CSI-ResourceConfig* IE(s). In another example, the L1 measurement reporting configuration(s) configures way(s) the UE 102 uses to transmit L1 measurement results/reports. For example, the L1 measurement report configuration(s) is/are *CSI-ReportConfig* IE(s). For example, The UE 102 transmits the L3 measurement report(s) to the CU 172 via the DU 174 in accordance with the L3 measurement configuration(s). The UE 102 transmits the L1 measurement report(s) to the DU 174 in accordance with the L1 measurement configuration(s) or L1 measurement reporting configuration(s). In one implementations, the DU 174 does not transmit the L1 measurement report(s) to the CU 172.

[0044] In some implementations, the L1 measurement configuration(s) are dedicated RRC IE(s) specifically defined for, and dedicated to (e.g., in a relevant 3GPP specification such as TS 38.331), for a lower layer triggered mobility (LTM). In some implementations, the L1 measurement resource configuration(s) are dedicated RRC IE(s) specifically defined for, and dedicated to (e.g., in a relevant 3GPP specification such as TS 38.331), for the LTM. In

some implementations, the L1 measurement reporting configuration(s) are dedicated RRC IE(s) specifically defined for, and dedicated to (e.g., in a relevant 3GPP specification such as TS 38.331), for the LTM. In some implementations, each of the L1 measurement reporting configuration(s) can include a trigger event configuration configuring a trigger event to trigger the UE 102 to transmit a L1 measurement report. If the UE 102 detects the trigger event, the UE 102 transmits a L1 measurement report to the DU 174.

[0045] In some implementations, (each of) the L1 measurement report(s) can include at least one L1 measurement result. In some implementations, the at least L1 measurement result includes at least one L1-reference signal received power (L1-RSRP) value and/or at least one L1- Signal to Interference Noise Ratio (L1-SINR) value. For each of the L1 measurement report(s), the UE 102 transmits a PUCCH transmission including the L1 measurement report to the DU 174, in some implementations. That is, the UE 102 transmits the each of the L1 measurement report(s) on a PUCCH to the DU 174. In other implementations, for each of the L1 measurement report(s), the UE 102 transmits a PUSCH transmission including the L1 measurement report to the DU 174. That is, the UE 102 transmits the each of the L1 measurement report(s) on a PUSCH to the DU 174. In yet other implementations, the UE 102 transmits a portion of the L1 measurement report(s) on PUCCH(s) and the rest of the L1 measurement report(s) on physical UL shared channel(s) (PUSCH(s)) to the DU 174. That is, for each of the portion of the L1 measurement report(s), the UE 102 transmits a PUCCH transmission including the L1 measurement report to the DU 174, and for each of the rest of the L1 measurement report(s), the UE 102 transmits a PUSCH transmission including the L1 measurement report to the DU 174. In some implementations, each of the L1 measurement report(s) is a part of channel state information (CSI) (i.e., a CSI component) or CSI. In some implementations, the UE 102 can include other CSI component(s) in (each of) the PUCCH transmission(s) and/or PUSCH transmission(s) described above. In one implementation, the other CSI component(s) include such as a channel quality indicator (CQI), a Precoding Matrix Indicator (PMI), a CSI-RS Resource Indicator (CRI), a Synchronization Signal (SS)/ Physical Broadcast Channel (PBCH) Resource Block Indicator (SSBRI), a Layer Indicator (LI), and/or a Rank Indicator (RI). In some implementations, the UE 102 does not transmit the L1 measurement report(s) in format of RRC message(s) to the DU 174.

[0046] In some implementations, each of the L3 measurement report(s) can include at least one L3 measurement result. In some implementations, the at least one L3 measurement result

includes at least one RSRP (value) and/or at least one SINR (value). In one implementation, the UE 102 transmits each of the L3 measurement report(s) on a PUSCH to the CU 172 via the DU 174. In some implementations, each of the L3 measurement report(s) can be a RRC message (e.g., *MeasurementReport* message). In some implementations, each of the L3 measurement configuration(s) includes a particular measurement identity (e.g., *measId*) and each of the L3 measurement report(s) includes a particular measurement identity in a particular L3 measurement configuration. When the CU 172 receives a L3 measurement report including a measurement identity and a L3 measurement result from the UE 102 via the DU 174, the CU 172 can determine that the L3 measurement report is associated to a L3 measurement configuration identified by the measurement identity.

[0047] In some alternative implementations, for each of the at least one measurement report (e.g., L1 measurement report(s)), the UE 102 transmits a MAC control element (CE) including the measurement report to the DU 174 in the event 304. To transmit the MAC CE(s), the UE 102 generate one or more MAC PDUs each including one or more of the MAC CE(s) to the DU 174 in the event 304.

[0048] In some implementations, the UE 102 performs measurements on one or more reference signals in accordance with the at least one measurement configuration. The one or more reference signals can include one or more Synchronization Signal (SS)/ Physical Broadcast Channel (PBCH) Resource Blocks (SSBs) and/or one or more CSI-RSs. The UE 102 obtains the at least one L1 measurement result and/or at least one L3 measurement result from the measurements. The DU 174 transmits the one or more reference signals on the cell 124A and other cell(s) (e.g., the cell 124B, the cell 124C and/or cell(s) not shown in Fig. 1A).

[0049] After (e.g., in response to) receiving one or some of the at least one measurement report from the UE 102, the base station 104 (i.e., the CU 172 or DU 174) determines to prepare a first cell (e.g., the cell 124B) for LTM for the UE 102. In some implementations, the base station 104 determines to prepare the first cell for the UE 102 because the at least one measurement report indicates that the first cell could be used by the base station 104 to communicate with the UE 102. In some implementations, the base station 104 determines to prepare the first cell for the UE 102 because the at least one measurement report indicates that the first cell qualifies to be a candidate cell that could be used for communication with the UE 102. In some implementations, if the L3 measurement report(s) indicates that signal strength and/or quality of the first cell is above a first predetermined threshold, is better than

strength and/or quality of the cell 124A, and/or is better than strength and/or quality of the cell 124A by a first predetermined threshold, the CU 172 determines to prepare the first cell for the UE 102. In other implementations, if the L1 measurement report(s) indicates that signal strength and/or quality of the first cell is above a first predetermined threshold, is better than signal strength and/or quality of the cell 124A, and/or is better than signal strength and/or quality of the cell 124A by a first predetermined threshold, the DU 174 determines to prepare the first cell for the UE 102. Alternatively, the base station 104 determines to prepare the first cell for the UE 102 regardless of whether a measure report is received from the UE 102 or not.

[0050] In the case that the CU 172 determines to prepare the first cell for LTM, the CU 172 transmits 308 a first CU-to-DU message to the DU 174 to prepare the first cell for the UE 102. In some implementations, the CU 172 includes a cell identity (ID) of the first cell in the first CU-to-DU message to request the DU 174 to prepare the first cell for LTM for the UE 102. For example, the cell ID is cell global identity (CGI). In another example, the cell ID is a portion of the CGI. In yet another example, the cell ID is a physical cell ID (PCI). In response to the first CU-to-DU message, the DU 174 generates a first LTM DU configuration (referred to herein after as LTM DU configuration 1) for the UE 102, which configures the first cell for LTM. The DU 174 then transmits 310 a first DU-to-CU message including the LTM DU configuration 1 to the CU 172 in response to the first CU-to-DU message. In some implementations, the DU 174 can include the cell ID 1 together with the LTM DU configuration 1 in an IE of the first DU-to-CU message to indicate that the LTM DU configuration 1 is associated with the first cell (i.e., the cell ID 1). In the case that the DU 174 determines to prepare the first cell, the DU 174 initiates transmission of the first DU-to-CU message to the CU 172 instead of in response to a CU-to-DU message received from the CU 172.

[0051] In some implementations, the DU 174 includes, in the first DU-to-CU message, the cell ID of the first cell associated with the LTM DU configuration 1 to indicate that the LTM DU configuration 1 is configured for or associated with the first cell. The CU 172 identifies the LTM DU configuration 1 is configured for or associated with the first cell. In some scenarios and implementations, the CU 172 can include additional cell ID(s) (e.g., cell ID(s) 2, ..., N) in the first CU-to-DU message to prepare additional cell(s) (e.g., cell(s) 2, ..., N) for LTM for the UE 102, and the DU 174 includes additional LTM DU configuration(s) (e.g., LTM DU configuration(s) 2, ..., N) each configuring a particular cell of the additional cell(s),

as described below. In such cases, the DU 174 includes, in the first DU-to-CU message, the additional cell ID(s) respectively associated with the additional LTM DU configuration(s) to indicate that which LTM DU configuration is associated to which cell (ID). The cell(s) 1 and/or 2, ..., N are candidate cell(s).

[0052] In some implementations, the CU 172 does not include a (reference) LTM DU configuration in the first CU-to-DU message. In such cases, the DU 174 generates a reference LTM DU configuration, generates the LTM DU configuration(s) 1 and/or 2, ..., N (i.e., non-reference LTM DU configuration(s)) based on the reference LTM DU configuration, and includes the reference LTM DU configuration in the first DU-to-CU message. In other implementations, the CU 172 includes a reference LTM DU configuration in the first CU-to-DU message. In such cases, the DU 174 generates the LTM DU configuration(s) 1, and/or 2, ..., N which are delta configuration(s) to augment the reference LTM DU configuration. In yet other implementations, the CU 172 includes a reference LTM DU configuration (e.g., a first reference LTM DU configuration) in the first CU-to-DU message. In such cases, the DU 174 generates a reference LTM DU configuration (e.g., a second reference LTM DU configuration) replacing the first reference LTM DU configuration, generates the LTM DU configuration(s) 1 and/or 2, ..., N based on the second reference LTM DU configuration, and includes the second reference LTM DU configuration in the first DU-to-CU message.

[0053] In some implementations, the reference LTM DU configuration includes physical layer configuration parameters, MAC configuration parameters, and/or RLC configuration parameters. In some implementations, the reference LTM DU configuration is *CellGroupConfig* IE defined in 3GPP specification 38.331. In other implementations, the reference LTM DU configuration includes configuration parameters in the *CellGroupConfig* IE. In some implementations, the reference LTM DU configuration includes a *CSI-MeasConfig* IE or configuration parameters for channel state information (CSI) measurement and/or reporting.

[0054] In some implementations, the reference LTM DU configuration is different from the serving DU configuration. In some implementations, a portion of the reference LTM DU configuration is the same as a portion of the serving DU configuration and the rest of the reference LTM DU configuration is different from the rest of the serving DU configuration. In other implementations, the reference LTM DU configuration is the same as the serving DU configuration.

[0055] After receiving the first DU-to-CU message, the CU 172 generates a RRC reconfiguration message (e.g., an *RRCReconfiguration* message) including the LTM DU configuration 1 and transmits 316 a second CU-to-DU message including the RRC reconfiguration message to the DU 174. In some implementations, the CU 172 includes the reference LTM DU configuration in the RRC reconfiguration message 316. In other implementations, the CU 172 does not include a/the reference LTM DU configuration in the RRC reconfiguration message 316. In some implementations, if the CU 172 transmits the reference LTM DU configuration to the UE 102 during the event 302, the CU 172 does not include the reference LTM DU configuration in the RRC reconfiguration message 316. In other implementations, if the CU 172 receives the reference LTM DU configuration from the DU 174, the CU 172 includes the LTM DU configuration in the RRC reconfiguration message 316. Otherwise, if the CU 172 does not receive a reference LTM DU configuration from the DU 174, the CU 172 does not include the reference LTM DU configuration in the RRC reconfiguration message 316.

[0056] In some implementations, the CU 172 includes the LTM DU configuration 1 and/or the LTM CU configuration 1 in a first container (e.g., a field/IE) and includes the first container (e.g., LTM configuration 1) in the RRC reconfiguration message of the events 316 and 318. In such cases, the CU 172 generates the first container. The first container is to indicate the UE 102 not to apply the LTM DU configuration 1 and/or the LTM CU configuration 1 immediately. In some scenarios or implementations, the UE 102 receives a RRC reconfiguration message (e.g., the RRC reconfiguration message of the event 318) including a configuration (e.g., the LTM DU configuration 1). If the configuration is included in the first container, the UE 102 refrains from immediately applying the configuration. Otherwise, if the configuration is not included in the first container, the UE 102 can apply the configuration immediately. In some implementations, the first container can be a first addition or modification list (e.g., *ltm-ConfigToAddModList* field, *LTM-ConfigToAddModList* IE, *ltm-CandidateConfigToAddModList* field, or *LTM-CandidateConfigToAddModList* IE). The CU 172 includes the LTM DU configuration 1 and/or the LTM CU configuration 1 in a first element (referred to herein after as element 1) of the first addition or modification list. For example, the element 1 can be an addition or modification IE (*ltm-ConfigToAddMod* field, *LTM-ConfigToAddMod* IE, *ltm-CandidateConfigToAddMod* field, or *LTM-CandidateConfigToAddMod* IE). When the UE 102 receives the first addition or modification list, the UE 102 can store the first addition or

modification list, e.g., in a variable in its random access memory (RAM). In other alternative implementations, the DU 174 generates the first container and includes the first container in the first DU-to-CU message. In yet other alternative implementations, the DU 174 generates the element 1 and includes the element 1 in the first DU-to-CU message.

[0057] In some implementations, the CU 172 includes a LTM CU configuration 1 in the RRC reconfiguration message 316, the first container or the element 1, where the LTM CU configuration 1 associated with the LTM DU configuration 1. To associate the LTM CU configuration 1 with the LTM DU configuration 1, the CU 172 can include the LTM CU configuration 1 and the LTM DU configuration in the element 1. In some implementations, the CU 172 includes LTM CU configuration(s) 2, ..., N in the RRC reconfiguration message 316 or the second container, where the LTM CU configuration(s) 2, ..., N associated with the LTM DU configuration(s) 2, ..., N, respectively. To associate the LTM CU configuration(s) 2, ..., N with the LTM DU configuration(s) 2, ..., N, the CU 172 can include the LTM CU configuration(s) 2, ..., N and the LTM DU configuration(s) in the element(s) 2, ..., N, respectively. In other implementations, the CU 172 includes, in the element(s) 2, ..., N, the LTM CU configuration(s) 2, ..., N associated with the LTM DU configuration(s) 2, ..., N, respectively. Alternatively, the CU 172 does not include, in the RRC reconfiguration message 316, LTM CU configuration(s) for some or all of the LTM DU configuration 1 and/or LTM DU configuration(s) 2, ..., N.

[0058] After receiving the RRC reconfiguration message 316, the DU 174 transmits 318 the RRC reconfiguration message to the UE 102. In response, the UE 102 transmits 320 a RRC reconfiguration complete message (e.g., an *RRCReconfigurationComplete* message) to the DU 174, which in turn transmits 322 a second DU-to-CU message including the RRC reconfiguration complete message to the CU 172. In some implementations, the CU 172 performs security protection (e.g., integrity protection and/or encryption) on the RRC reconfiguration message. For example, the CU 172 generates a message authentication code for integrity (MAC-I) for the RRC reconfiguration message, encrypts the RRC reconfiguration message and the MAC-I to obtain an encrypted RRC reconfiguration message and an encrypted MAC-I, and transmits a PDCP PDU including the encrypted RRC reconfiguration message and encrypted MAC-I to the UE 102 via the DU 174 in the events 316 and 318. When the UE 102 receives the PDCP PDU from the CU 172 via the DU 174 (i.e., events 316 and 318), the UE 102 decrypts the encrypted RRC reconfiguration and encrypted MAC-I to obtain the RRC reconfiguration message and MAC-I and verifies

whether the MAC-I is valid. If the UE 102 verifies the MAC-I is invalid, the UE 102 discards or ignores the RRC reconfiguration message. In some implementations, the UE 102 can perform a RRC connection reestablishment procedure in response to the invalid MAC-I. Otherwise, if the UE 102 verifies the MAC-I is valid, the UE 102 can process the RRC reconfiguration. The UE 102 refrains from applying (i.e., executing) the LTM DU configuration 1 until receiving a configuration activation command activating the LTM DU configuration 1 (e.g., the event 330).

[0059] The events 308 (optional) and 310 are collectively referred to in Fig. 3 as a LTM preparation procedure 390. The events 316, 318, 320, 322 are collectively referred to in Fig. 3 as a LTM configuration delivery procedure 394.

[0060] In some implementations, the first CU-to-DU message is a *UE Context Modification Request* message, and the first DU-to-CU message is a *UE Context Modification Response* message or *UE Context Modification Required* message. In the case of the *UE Context Modification Required* message, the CU 172 can transmit a *UE Context Modification Confirm* message to the DU 174 in response to *UE Context Modification Required* message. In some implementations, the second CU-to-DU message is a *DL RRC Message Transfer* message. In other implementations, the second CU-to-DU message is a *UE Context Modification Request* message and the DU 174 can transmit a second DU-to-CU message (e.g., *UE Context Modification Response* message) to the CU 172 in response to the second CU-to-DU message.

[0061] In some implementations, the CU 172 can include a reference LTM CU configuration in the RRC reconfiguration message 316 or the first container. In some implementations, the CU 172 might generate the LTM CU configuration 1 (i.e., non-reference LTM CU configuration) as a delta configuration to augment the reference LTM CU configuration. Similarly, the CU 172 might generate some or all of the LTM CU configuration(s) 2, ..., N as delta configuration(s) to augment the reference LTM CU configuration. Alternatively, in the RRC reconfiguration message 316 or the first container, the CU 172 includes the reference LTM CU configuration and does not include a non-reference LTM CU configuration. In some implementations, the CU 172 includes the reference LTM CU configuration and/or the reference LTM DU configuration in an additional container (e.g., reference LTM configuration) and include the additional container in the RRC reconfiguration message 316.

[0062] In some implementations, the reference LTM CU configuration is different from the serving CU configuration. In some implementations, a portion of the reference LTM CU configuration is the same as a portion of the serving CU configuration and the rest of the reference LTM CU configuration is different from the rest of the serving CU configuration. In yet other implementations, the reference LTM CU configuration is the same as the serving LTM CU configuration.

1) CU assigns an ID for the LTM DU configuration 1

[0063] In some implementations, the CU 172 includes, in the RRC reconfiguration message, a first LTM ID (referred to herein after as ID 1) for identifying the LTM DU configuration 1 or the element 1. In some implementations, the CU 172 includes the ID 1 in the first container or element 1. In some implementations, the CU 172 assigns the ID 1. In other implementations, the CU 172 receives the ID 1 from the DU 174 in the first DU-to-CU message, as described below.

[0064] In the case that the CU 172 assigns or generates the ID 1, the CU 172 can transmit the ID 1 to the DU 174, and the DU 174 associates the ID 1 with the LTM DU configuration 1. In some implementations, in the first CU-to-DU message, the CU 172 includes the ID 1 and indicates the ID 1 is associated with the LTM DU configuration 1. In other implementations, after receiving the first DU-to-CU message, the CU 172 transmits 312 a third CU-to-DU message including the ID 1 to the DU 174 instead of including the ID 1 in the first CU-to-DU message. In some implementations, in the third CU-to-DU message, the CU 172 can include the LTM DU configuration 1 and the ID 1 and indicate the association between the ID 1 and LTM DU configuration 1. Thus, the DU 174 can directly associate the ID 1 with the LTM DU configuration 1. In other implementations, in the third CU-to-DU message, the CU 172 can include the cell ID 1 and the ID 1 (i.e., the first LTM ID) and indicate the association between the cell ID 1 and the ID 1. Thus, the DU 174 can associate the ID 1 with the LTM DU configuration 1, based on the association between the cell ID 1 and the ID 1 and the association between the cell ID 1 and the LTM DU configuration 1. In yet other implementations, in the third CU-to-DU message, the CU 172 can include the LTM DU configuration 1, the cell ID 1 and the ID 1 and indicate the association between the ID 1, LTM DU configuration 1 and the cell ID 1. In some implementations, the DU 174 can transmit 314 a third DU-to-CU message to the CU 172 in response to the third CU-to-DU message. In some implementations, the third CU-to-DU message and third DU-to-CU

message are UE Context Modification Request message and UE Context Modification Response message. The events 312 (optional) and 314 (optional) are collectively referred to in Fig. 3 as a LTM ID assignment procedure 392. In other implementations, the CU 172 can include the ID 1, the cell ID 1 and/or the LTM DU configuration 1 in the second CU-to-DU message as described above. Thus, the third CU-to-DU message can be omitted.

[0065] In the case that the CU 172 includes the ID 1 in the first CU-to-DU message, the DU 174 can include the ID 1 in the LTM DU configuration 1, first container or element 1. Alternatively, the DU 174 does not include the ID 1 in the LTM DU configuration 1, first container and/or element 1.

2) DU assigns an ID for the LTM DU configuration 1

[0066] In some alternative implementations, the DU 174 assigns the ID 1 identifying the LTM DU configuration 1. In some implementations, the DU 174 includes the ID 1 in the first DU-to-CU message. The CU 172 can include the ID 1 in the RRC reconfiguration message as described above. In other implementations, the DU 174 includes the ID 1 in the LTM DU configuration 1, first container or element 1. Thus, the CU 172 does not include an ID identifying the LTM DU configuration 1 in the RRC reconfiguration message, first container and/or element 1.

[0067] In some implementations, the CU 172 includes the reference LTM DU configuration in the first container. For example, the CU 172 includes the reference LTM DU configuration in a field of the first container, different from a field of the first container including the LTM DU configuration 1. In other implementations, the CU 172 includes the reference LTM DU configuration in the RRC reconfiguration message 316 and outside the first container. For example, the CU 172 generates a third container (e.g., a field/IE) to include the first container and the reference LTM DU configuration and includes the third container in the RRC reconfiguration message 316. In yet other implementations, the DU 174 includes the reference LTM DU configuration in the first container. For example, the DU 174 includes the reference LTM DU configuration in a field of the first container, different from a field of the first container including the LTM DU configuration 1. In yet other implementations, the DU 174 generates a fourth container (e.g., a field/IE) to include the first container and the reference LTM DU configuration and includes the fourth container in the first DU-to-CU message 310. In such cases, the CU 172 includes the fourth container in the RRC reconfiguration message 316. Alternatively, the CU 172 retrieves the reference LTM

DU configuration and the LTM DU configuration 1 from the fourth container and includes the reference LTM DU configuration and the LTM DU configuration 1 as described above.

[0068] In some implementations, neither the CU 172 nor the DU 174 assign an ID to identify the reference LTM DU configuration. In some implementations, neither the CU 172 nor the DU 174 assign an ID to identify the reference LTM CU configuration.

[0069] In some implementations, the LTM DU configuration 1 includes a plurality of configuration parameters for the UE 102 to communicate with the DU 174 on the first cell. In some implementations, the plurality of configuration parameters include physical layer configuration parameters (e.g., *PhysicalCellGroupConfig* IE), MAC layer configuration parameters (e.g., *MAC-CellGroupConfig* IE) and/or RLC configuration parameters (e.g., *RLC-BearerConfig* IE(s)). In some further implementations, the plurality of configuration parameters include a special cell configuration (e.g., *SpCellConfig* IE) and/or one or more SCell configurations (e.g., *SCellConfig* IE(s)). In some implementations, the LTM DU configuration 1 is *CellGroupConfig* IE defined in 3GPP specification 38.331. In other implementations, the LTM DU configuration 1 includes configuration parameters in the *CellGroupConfig* IE.

[0070] In some implementations, the LTM CU configuration 1 includes PDCP configuration parameters, measurement configuration parameters, and/or radio bearer configuration parameters. In some implementations, the LTM CU configuration 1 includes a *MeasConfig* IE and/or a *RadioBearerConfig* IE defined in 3GPP specification 38.331 or includes configuration parameters in the *MeasConfig* IE and/or *RadioBearerConfig* IE. In some implementations, the LTM DU configuration 1 includes a *CSI-MeasConfig* IE or configuration parameters for channel state information (CSI) measurement and reporting. In other implementations, the LTM CU configuration 1 includes a *CSI-MeasConfig* IE or configuration parameters for channel state information (CSI) measurement and reporting.

[0071] In some implementations, the DU 174 includes a random access configuration in the LTM DU configuration 1. In other implementations, the DU 174 does not include a random access configuration in the LTM DU configuration 1. In some implementations, if the cell 124A and first cell are not synchronized, the DU 174 determines to include the random access configuration in the LTM DU configuration 1. Otherwise, if the cell 124A and first cell are synchronized, the DU 174 determines to not include the random access configuration in the LTM DU configuration 1. In other implementations, if the DU 174

determines that the UE 102 has not synchronized in UL with the first cell, the DU 174 determines to include the random access configuration in the LTM DU configuration 1. Otherwise, if the DU 174 determines that the UE 102 has synchronized in UL with the first cell, the DU 174 determines to not include the random access configuration in the LTM DU configuration 1. If the LTM DU configuration 1 includes the random access configuration, the UE 102 performs the random access procedure in the event 332 in accordance with the random access configuration, as described below. Otherwise, if the LTM DU configuration 1 does not include the random access configuration, the UE 102 skips or refrains from performing the random access procedure of the event 332 in response to the LTM DU configuration 1 excluding the random access configuration.

[0072] In some implementations, the DU 174 includes random access configuration parameters in the LTM DU configuration 1 and/or the reference LTM DU configuration regardless of whether the cell 124A and first cell are synchronized or not. The UE 102 performs the random access procedure in the event 332 in accordance with the random access configuration parameters, as described below.

[0073] In some implementations, if the cell 124A and first cell are synchronized, the DU 174 determines to include, in the LTM DU configuration 1, a first indication configuring the UE 102 not to perform a random access procedure on the first cell. Otherwise, if the cell 124A and first cell are not synchronized, the DU 174 determines to not include the first indication in the LTM DU configuration 1. In other implementations, if the DU 174 determines that the UE 102 has synchronized in UL with the first cell, the DU 174 determines to include the first indication in the LTM DU configuration 1. Otherwise, if the DU 174 determines that the UE 102 has not synchronized in UL with the first cell, the DU 174 determines to not include the first indication in the LTM DU configuration 1. If the LTM DU configuration 1 includes the first indication, the UE 102 skips or refrains from performing the random access procedure of the event 332 in accordance with or in response to the first indication. Otherwise, if the LTM DU configuration 1 does not include the first indication, the UE 102 performs the random access procedure in accordance with the random access configuration in the event 332, in response to the LTM DU configuration 1 excluding the first indication, as described below.

[0074] In some implementations, the DU 174 includes a reconfiguration with sync configuration (e.g., *ReconfigurationWithSync* IE) in the LTM DU configuration 1 or special

cell configuration. In other implementations, the DU 174 does not include a reconfiguration with sync configuration (e.g., *ReconfigurationWithSync* IE) in the LTM DU configuration 1 or special cell configuration. In some implementations, if the cell 124A and first cell are not synchronized, the DU 174 determines to include the reconfiguration with sync configuration in the LTM DU configuration 1. Otherwise, if the cell 124A and first cell are synchronized, the DU 174 determines to not include the reconfiguration with sync configuration in the LTM DU configuration 1. In other implementations, if the DU 174 determines that the UE 102 has not synchronized in UL with the first cell, the DU 174 determines to include the reconfiguration with sync configuration in the LTM DU configuration 1. Otherwise, if the DU 174 determines that the UE 102 has synchronized in UL with the first cell, the DU 174 determines to not include the reconfiguration with sync configuration in the LTM DU configuration 1. In some implementations, if the LTM DU configuration 1 includes the reconfiguration with sync configuration, the UE 102 performs the random access procedure in the event 332 as described below, in response to or in accordance with the reconfiguration with sync configuration. Otherwise, if the LTM DU configuration 1 does not include the reconfiguration with sync configuration, the UE 102 skips or refrains from performing the random access procedure of the event 332. In some implementations, the DU 174 includes a cell ID (i.e., cell ID 1) of cell 1 (i.e., the first cell) in the LTM DU configuration 1. In one implementation, the cell ID 1 can be a PCI. In another implementation, the cell ID 1 is a CGI. In some implementations, the cell ID 1 included in the LTM DU configuration 1 is a PCI, while the cell ID 1 included in the first CU-to-DU message is a CGI. In some further implementations, the LTM DU configuration 1 includes a cell index 1 indexing the cell ID 1 or the first cell. The cell index 1 is not a cell ID. The cell index takes fewer bits than the cell ID. In some implementations, the CU 172 sets the cell index 1 to a value and includes the cell index 1 in the first CU-to-DU message of the event 308.

[0075] In some implementations, after (e.g., in response to) receiving one or some of the at least one measurement report of the event 304, the base station 104 (i.e., the CU 172 or DU 174) determines to prepare additional cell(s) (i.e., cell(s) 2, ..., N) of the base station 104 for LTM for the UE 102. In one implementation, the base station 104 determines to prepare the additional cell(s) for LTM for the UE 102 because the at least one measurement report indicates that the additional cell(s) could be used by the base station 104 to communicate with the UE 102. The additional cell(s) can include the cell 124C and/or cell(s) other than the cells 124A, 124B and 124C. In some implementations, if the L3 measurement report(s)

indicates that signal strength and/or quality of a particular cell of the additional cell(s) is above a respective predetermined threshold and/or is better than the cell 124A, the CU 172 determines to prepare the particular cell for LTM for the UE 102. In other implementations, if the L1 measurement report(s) indicates that signal strength and/or quality of a particular cell of the additional cell(s) is above a first predetermined threshold and/or is better than the cell 124A, the DU 174 determines to prepare the particular cell for LTM for the UE 102. In one implementation, the respective predetermined threshold(s) for the additional cells can be different from the first predetermined threshold. In another implementation, the respective predetermined threshold(s) for the additional cell(s) can be the same as the first predetermined threshold. In some implementations, the respective predetermined thresholds for the additional cells can be the same or different. Alternatively, the base station 104 determines to prepare the additional cell(s) for the UE 102 regardless of whether a measurement report is received from the UE 102 or not.

[0076] In the case that the CU 172 determines to prepare the additional cell(s), the CU 172 initiates and performs at least one additional LTM preparation procedure (LTM preparation procedure(s)) with the DU 174 to prepare the additional cell(s) for LTM, where each of the LTM preparation procedure(s) is similar to the procedure 390. In the case that the DU 174 determines to prepare the additional cell(s), the DU 174 initiates and performs at least one additional LTM preparation procedure (LTM preparation procedure(s)) with the CU 172 to prepare the additional cell(s) for LTM, where each of the LTM preparation procedure(s) is similar to the procedure 390.

[0077] In some implementations, the CU 172 and DU 174 perform LTM preparation procedure(s) 2, ..., N to prepare the cell(s) 2, ..., N, respectively, similar to the procedure 390. The CU 172 can include the cell ID(s) 2, ..., N in CU-to-DU message(s) 2, ..., N in the LTM preparation procedure(s) 2, ..., N, respectively, similar to the first CU-to-DU message. In the LTM preparation procedure(s) 2, ..., N, the DU 174 generates LTM DU configuration(s) 2, ..., N configuring the cell(s) 2, ..., N and includes the LTM DU configuration(s) 2, ..., N in DU-to-CU message(s) 2, ..., N, respectively, as described for the LTM DU configuration 1. In the case that the DU 174 receives the CU-to-DU message(s) 2, ..., N, the DU-to-CU message(s) 2, ..., N responds to the CU-to-DU message(s) 2, ..., N, respectively. "N" is an integer and larger than one. For example, "N" is 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 or 16. In another example, the maximum number of "N" is 4, 8, 16 or

32. Examples and implementations of the LTM DU configuration 1 can apply to the LTM DU configuration(s) 2, ..., N.

[0078] In other implementations, the CU 172 and DU 174 performs a single LTM preparation procedure (i.e., the LTM preparation procedure 390) to prepare the cell(s) 1, 2, ..., N. In such cases, the DU 174 includes the LTM DU configuration(s) 1, 2, ..., N for the cell(s) 1, 2, ..., N, respectively in the first DU-to-CU message. In the first DU-to-CU message, the DU 174 can include the cell ID(s) 1, 2, ..., N respectively associated with the LTM DU configuration(s) 1, 2, ..., N to indicate that the LTM DU configuration(s) 1, 2, ..., N are configured for the cell ID(s) 1, 2, ..., N, respectively. In the case that the CU 172 determines to perform the LTM preparation procedure 390, the CU 172 includes the cell ID(s) 1, 2, ..., N in the first CU-to-DU message to request the DU 174 to prepare the cell(s) 1, 2, ..., N, respectively, for LTM.

[0079] After receiving the LTM DU configuration(s) 2, ..., N from the DU 174, the CU 172 can include the LTM DU configuration(s) 2, ..., N in the first container. In some implementations, the CU 172 can include the LTM DU configuration(s) 2, ..., N in element(s) 2, ..., N, respectively, and includes the element(s) 2, ..., N in the first container. In some implementations, the CU 172 includes, in the RRC reconfiguration message, LTM ID(s) (i.e., ID(s) 2, ..., N) for identifying the LTM DU configuration(s) 2, ..., N, respectively. In some implementations, the CU 172 includes the ID(s) 2, ..., N in the first container. For example, the CU 172 can include the ID(s) 2, ..., N and LTM DU configuration(s) 2, ..., N in the element(s) 2, ..., N in the first addition or modification list.

[0080] In some implementations, the CU 172 assigns the ID(s) 2, ..., N for the LTM DU configuration(s) 2, ..., N, respectively. In other implementations, the CU 172 receives the ID(s) 2, ..., N from the DU 174 in the first DU-to-CU message of the procedure 390. In yet other implementations, the CU 172 receives from the DU 174 the ID(s) 2, ..., N in the DU-to-CU message(s) 2, ..., N of the LTM preparation procedure(s) 2, ..., N, respectively.

[0081] In some implementations, the CU 172 can perform a LTM ID assignment procedure with the DU 174 for each of the LTM DU configuration(s) 2, ..., N, similar to the procedure 392. In other implementations, the CU 172 can include the ID(s) 2, ..., N and the LTM DU configuration(s) 2, ..., N in the third CU-to-DU message and indicate the association between the ID(s) 2, ..., N and the LTM DU configuration(s) 2, ..., N, respectively. Thus, the DU 174 can associate the LTM DU configuration(s) 2, ..., N with the

ID(s) 2, ..., N, respectively. In yet other implementations, the CU 172 can include the cell ID(s) 2, ..., N and the ID(s) 2, ..., N in the third CU-to-DU message and indicate the association between the cell ID(s) 2, ..., N and the ID(s) 2, ..., N, respectively. Thus, the DU 174 can associate the LTM DU configuration(s) 2, ..., N with the ID(s) 2, ..., N, respectively, based on the association between the cell ID(s) 2, ..., N and the ID(s) 2, ..., N and the association between the cell ID(s) 2, ..., N and the LTM DU configuration(s) 2, ..., N, respectively. In other implementations, the CU 172 can include the ID(s) 2, ..., N, the cell ID(s) 2, ..., N and/or the LTM DU configuration(s) 2, ..., N in the second CU-to-DU message as described above. Thus, the third CU-to-DU message can be omitted. In yet other implementations, the CU 172 can include the ID(s) 2, ..., N in the first CU-to-DU message and indicate the ID(s) 2, ..., N is/are respectively associated with the cell ID(s) 2, ..., N. In one implementation, the DU 174 includes the ID(s) 2, ..., N in the LTM DU configuration(s) 2, ..., N. Thus, the CU 172 does not include the ID(s) 2, ..., N in the RRC reconfiguration message, first container and/or element(s) 2, ..., N.

[0082] In some alternative implementations, the DU 174 assigns the ID(s) 2, ..., N. In some implementations, the DU 174 includes the ID(s) 2, ..., N in the first DU-to-CU message of the procedure 390. In yet other implementations, the DU 174 includes the ID(s) 2, ..., N in the DU-to-CU message(s) 2, ..., N of the LTM preparation procedure(s) 2, ..., N. The CU 172 can include the ID(s) 2, ..., N in the RRC reconfiguration message. In other implementations, the DU 174 includes the ID(s) 2, ..., N in the LTM DU configuration(s) 2, ..., N. Thus, the CU 172 does not include an ID (e.g., LTM ID) identifying each of the LTM DU configuration(s) 2, ..., N in the RRC reconfiguration message, first container and/or element 1.

[0083] In some alternative implementations, the CU 172 can generate a second container including the LTM DU configuration(s) 2, ..., N or element(s) 2, ..., N instead of using the first container. The CU 172 then transmits an additional RRC reconfiguration message including the second container to the UE 102 via the DU 174, similar to the events 316 and 318. In response, the UE 102 transmits an additional RRC reconfiguration complete message to the CU 172 via the DU 174, similar to the events 320 and 322. In some implementations, the second container can be a second addition or modification list (e.g., *ltm-ConfigToAddModList* field, *LTM-ConfigToAddModList* IE, *ltm-CandidateConfigToAddModList* field, or *LTM-CandidateConfigToAddModList* IE), and each of the element(s) 2, ..., N can be an addition or modification IE (e.g., *ltm-ConfigToAddMod*

field, *LTM-ConfigToAddMod* IE, *lrm-CandidateConfigToAddMod* field, or *LTM-CandidateConfigToAddMod* IE). When the UE 102 receives the second addition or modification list, the UE 102 can store the second addition or modification list together with the first addition or modification list, e.g., in a variable in its random access memory (RAM).

[0084] In some implementations, the DU 174 includes cell ID(s) 2, ..., N in the LTM DU configuration(s) 2, ..., N to identify the cell(s) 2, ..., N, respectively. In one implementation, each of the cell ID(s) 2, ..., N is a PCI. In some further implementations, the LTM DU configuration(s) 2, ..., N includes cell index(es) 2, ..., N indexing the cell ID(s) 2, ..., N or the cell(s) 2, ..., N, respectively. In the case that the CU 172 prepares the cell(s) 2, ..., N for LTM in the procedure 390, the CU 172 can set the cell index(es) 2, ..., N to different value(s) and include the cell index(es) 2, ..., N in the first CU-to-DU message of the event 308. In the case that the CU 172 prepares the cell(s) 2, ..., N in the additional LTM preparation procedure(s), the CU 172 can set the cell index(es) 2, ..., N to different values and include the cell index(es) 2, ..., N in CU-to-DU message(s) of the additional LTM preparation procedure(s). The CU 172 sets the cell index(es) 1, ..., N to different values. In some implementations, the cell ID(s) 1, ..., N in the LTM DU configuration(s) 1, ..., N are different from the cell ID(s) 1, ..., N in the CU-to-DU message(s) described above.

[0085] In some implementations, each of the LTM DU configuration(s) 1, ..., N includes physical configuration parameters, MAC configuration parameters, RLC configuration parameters and/or L1 measurement configuration(s). In some implementations, each of the LTM DU configuration(s) 1, ..., N can be a *CellGroupConfig* IE as defined in 3GPP specification 38.331. In other implementations, each of the LTM DU configuration(s) 1, ..., N include configuration parameters included in a *CellGroupConfig* IE as defined in 3GPP specification 38.331. In some further implementations, the plurality of configuration parameters in each of the LTM DU configuration(s) include a particular special cell configuration (e.g., *SpCellConfig* IE) and/or one or more SCell configurations (e.g., *SCellConfig* IE(s)). In some implementations, the LTM DU configuration(s) 1, ..., N are *CellGroupConfig* IE(s) defined in 3GPP specification 38.331. In other implementations, the LTM DU configuration(s) 1, ..., N include configuration parameters in the *CellGroupConfig* IE.

[0086] In some implementations, the CU 172 can include one or more additional LTM CU configurations in at least one of the element(s) 2, ..., N, the first container or the second

container. Each of the additional LTM CU configurations are associated with a particular LTM DU configuration of the LTM DU configuration(s) 2, ..., N. Examples and implementations of the additional LTM CU configurations are similar to the LTM CU configuration 1.

[0087] In some implementations, the CU 172 determines to release the LTM DU configuration M of the LTM DU configuration(s) 1, ..., N (or the element M of the element(s) 1, ..., M). $1 \leq M \leq N$. In response to the determination, the CU 172 transmits a RRC reconfiguration message to the UE 102 via the DU 174 to indicate the UE 102 to release the LTM DU configuration M or element M. In one implementation, the CU 172 generates a release list including the ID (i.e., LTM ID) M for releasing the LTM DU configuration M or element M and includes the release list in the RRC reconfiguration message. In response to the RRC reconfiguration message, the UE 102 releases the LTM DU configuration M or element M and transmits a RRC reconfiguration complete message to the CU 172 via the DU 174. In response to the determination, the CU 172 transmits a CU-to-DU message to the DU 174 to indicate the DU 174 to release the LTM DU configuration M. To indicate the DU 174 to release the LTM DU configuration M, the CU 172 can include the cell ID M or the ID (i.e., LTM ID) M in a release indication (e.g., a field or IE) in the CU-to-DU message. In response, the DU 174 releases the LTM DU configuration M and transmits a DU-to-CU message to the CU 172. In some implementations, the CU-to-DU message and DU-to-CU message are a UE Context Modification Request message and a UE Context Modification Response message, respectively.

[0088] In other implementations, the DU 174 determines to release the LTM DU configuration K. In response to the determination, the DU 174 transmits a DU-to-CU message to the CU 172 to release the LTM DU configuration K. To indicate the LTM DU configuration K is released, the DU 174 can include the cell ID K or the ID (i.e., LTM ID) K in a release indication (e.g., a field or IE) in the DU-to-CU message. $1 \leq K \leq N$. After (e.g., in response to) receiving the DU-to-CU message, the CU 172 generates a release list including the ID (i.e., LTM ID) K to release the LTM DU configuration K or element K and transmits a RRC reconfiguration message including the release list to the UE 102 via the DU 174. In response, the UE 102 releases the LTM DU configuration K or element K and transmits a RRC reconfiguration complete message to the UE 102 via the DU 174. The CU 172 can transmit a CU-to-DU message to the DU 174 in response to the DU-to-CU message. In some implementations, the DU-to-CU message and CU-to-DU message are a UE Context

Modification Required message and a UE Context Modification Confirm message, respectively.

[0089] After receiving the RRC reconfiguration in the event 318 or transmitting the RRC reconfiguration complete message in the event 320, the UE 102 transmits 324 at least one measurement report to the DU 174, similar to the event 304. In some implementations, the DU 174 may transmit 326 a DU-to-CU message including the at least one measurement report to the CU 172, similar to the event 306. In other implementations, the DU 174 does not transmit the at least one measurement report to the CU 172. In some implementations, the at least one measurement report of the event 324 include L1 measurement report(s) or L3 measurement report(s), as described for the event 304. In some implementations, the UE 102 transmits 324 the at least one measurement report on PUCCH(s) and/or PUSCH(s) to the DU 174, similar to the event 304. In other implementations, the UE 102 transmits 324 at least one MAC CE including the at least one measurement report to the DU 174, similar to the event 304. In some implementations, the UE 102 does not transmit the L1 measurement report(s) in format of RRC message(s) to the DU 174.

[0090] In some implementations, the UE 102 transmits 324 the at least one measurement report to the DU 174 in accordance with at least one measurement configuration. The at least one measurement configuration configures the UE 102 to perform measurements and report measurement results. The CU 172 transmits the at least one measurement configuration to the UE 102 via the DU 174. For example, the CU 172 can transmit one or more RRC messages (e.g., *RRCReconfiguration* message(s)) including the at least one measurement configuration to the UE 102 via the DU 174 in the event 302 and/or 316 and/or after the event 306 or 316. The one or more RRC messages may or may not include the RRC reconfiguration message of the event 316. In accordance with the at least one measurement configuration, the UE 102 performs measurements on one or more reference signals. The one or more reference signals can include one or more SSBs and/or one or more CSI-RSs. The UE 102 obtains the at least one L1 measurement result and/or at least one L3 measurement result from the measurements and includes the at least one L1 measurement result and/or at least one L3 measurement result in the at least measurement report of the event 324. The DU 174 transmits the one or more reference signals on the cell 124A, the cell 1 and/or the cell(s) 2, ..., N. The one or more reference signals can be CSI-RS(s) or SSB(s).

[0091] In some implementations, the at least one measurement configuration includes L3 measurement configuration(s) (e.g., *MeasConfig* IE(s)), as described for the event 304. In other implementations, the at least one measurement configuration includes L1 measurement configuration(s), as described for the event 304. For example, the L1 measurement configuration(s) can be *CSI-MeasConfig* IE(s) defined in 3GPP specification 38.331 v18.0.0 and/or later versions. The L1 measurement configuration(s) can include measurement report configuration(s). The UE 102 transmits the L1 measurement report(s) on PUCCH(s) or MAC CE(s) to the DU 174 in accordance with the measurement report configuration(s). The DU 174 receives the L1 measurement report(s) on PUCCH(s) or MAC CE(s) in accordance with the measurement report configuration(s). In some implementations, the measurement report configuration(s) are *CSI-ReportConfig* IE(s). In other implementations, each of the measurement report configuration(s) is a dedicated RRC IE (e.g. specifically defined for, and dedicated to the purposes of this procedure). In some implementations, (each of) the measurement report configuration(s) configures periodically reporting and/or event-triggered reporting of the L1 measurement result(s).

[0092] In yet other implementations, the at least one measurement configuration includes “LTM-dedicated-type” measurement configuration(s) specifically defined for and dedicated to LTM (e.g., LTM measurement configuration(s)). The LTM-dedicated-type measurement configuration can be defined in a relevant 3GPP specification. In some implementations, the LTM-dedicated-type measurement configuration(s) includes reference signal resource configuration(s) configuring resources where the DU 174 transmits reference signal(s). For example, the reference signal resource configuration(s) include CSI-RS(s) and/or SSB(s). In one implementation, the reference signal resource configuration(s) is/are *CSI-ResourceConfig* IE(s). In another implementation, the LTM-dedicated-type measurement configuration(s) include measurement report configuration(s), as described above. The UE 102 transmits the measurement report(s) on PUCCH(s) or MAC CE(s) to the DU 174 in accordance with the measurement report configuration(s). The DU 174 receives the measurement report(s) on PUCCH(s) or MAC CE(s) in accordance with the measurement report configuration(s). In such cases, the measurement report(s) can be L1 measurement report(s) or LTM-dedicated-type measurement report(s) (e.g., LTM measurement report(s)). In some implementations, the LTM-dedicated-type measurement configuration includes configuration parameters specifically defined for LTM in a relevant 3GPP specification.

[0093] After (e.g., in response to) receiving the at least one measurement report in the event 324, the DU 174 generates a first LTM command to activate the LTM DU configuration 1 (i.e., the first LTM command commands the UE 102 to apply the LTM DU configuration 1 or to perform a serving cell change to the cell 1). The DU 174 then transmits 330 the first LTM command to the UE 102. In some implementations, the DU 174 transmits the first LTM command on the cell 124A to the UE 102. In other implementations, the DU 174 transmits the first LTM command on the cell 124D to the UE 102. In some implementations, the DU 174 can include the ID 1 in the first LTM command to indicate the LTM DU configuration 1, and the UE 102 determines (e.g., identifies) the LTM DU configuration 1 or element 1 in accordance with the ID 1. In other implementations, the DU 174 can include the cell index 1 indexing the cell ID 1 in the first LTM command. The UE 102 determines (e.g., identifies) the LTM DU configuration 1 or element 1 based on the cell index 1. After determining the LTM DU configuration 1 or element 1, the UE 102 then applies the LTM DU configuration 1 and/or LTM CU configuration 1, in response to receiving the first LTM command.

[0094] In yet other implementations, the DU 174 can include a bit map in the first LTM command to activate the LTM DU configuration 1, instead of the ID 1 or cell index 1. The number of bits in the bit map is larger than or equal to “N”. In one implementation, bit 1, ..., N corresponds to the cell index(es) 1, ..., N, the ID(s) 1, ..., N, the LTM DU configuration(s) 1, ..., N or the element(s) 1, ..., N, respectively, and the DU 174 sets a corresponding bit (e.g., bit 1) in the bit map to a first value to indicate the cell index 1, the ID 1, the LTM DU configuration 1 or the element 1. Thus, the UE 102 can determine the cell index 1, the ID 1, LTM DU configuration 1, or element 1 in accordance with the bit 1 set to the first value in the bit map. In another implementation, bit 0, ..., N-1 corresponds to the cell index(es) 1, ..., N, the ID(s) 1, ..., N, the LTM DU configuration(s) 1, ..., N or the element (s) 1, ..., N, respectively, and the DU 174 sets a corresponding bit (e.g., bit 0) in the bit map to a first value to indicate the cell index 1, the ID 1 the LTM DU configuration 1 or the element 1. Thus, the UE 102 can determine the cell index 1, the ID 1 LTM DU configuration 1 or element 1 in accordance with the bit 0 set to the first value in the bit map. In such implementations, the DU 174 sets the remaining bits in the bit map to a second value to indicate that the rest of the LTM DU configuration(s) 1, ..., N is/are not activated. In some implementations, the first value is one and the second value is zero. In other implementations, the first value is zero and the second value is one. Generally, if the DU 174

determines to activate the LTM DU configuration L or change a serving cell to the cell L , the DU 174 can set the corresponding bit (e.g., bit L or bit $L-I$) in the bit map to the first value and set the remaining bits to the second value, where $I \leq L \leq N$. In some implementations, the DU 174 sets at most one bit in the bit map to the first value.

[0095] In some implementations, the at least one measurement report (e.g., L1 measurement report(s) or new-type measurement report(s)) of the event 324 includes at least one measurement result for the first cell, TRP(s) of the first cell or reference signal(s) transmitted on the first cell. The reference signal(s) can be CSI-RS(s) or SSB(s). The DU 174 determines to activate the LTM DU configuration 1 or transmit the first LTM command, based on the at least one measurement result. In some implementations, the DU 174 determines to activate the LTM DU configuration 1 because, when or if the at least one measurement result is above a second predetermined threshold. In some implementations, the at least one measurement result includes L1-RSRP value(s), L1-RSRQ value(s) and/or L1-SINR value(s). In other implementations, the at least one measurement result includes RSRP value(s), RSRQ value(s) and/or SINR value(s) for the LTM-dedicated-type measurement report(s). In some implementations, the second predetermined threshold is different from the first predetermined threshold. In one implementation, the second predetermined threshold is larger than the first predetermined threshold. In this case, the at least one measurement result indicates that the first cell is suitable for communication with the UE 102. In another implementation, the second predetermined threshold is equal to the first predetermined threshold. In this case, the at least one measurement result indicates that the first cell has been continuously above the second predetermined threshold or the first predetermined threshold. This indicates that the first cell is suitable for communication with the UE 102. Thus, the DU 174 determines to activate the LTM DU configuration 1 in response to that signal strength or quality of the first cell is above the second predetermined threshold for the UE 102.

[0096] In some implementations, the at least one measurement report (e.g., L3 measurement report(s)) of the events 324 and 326 includes at least one measurement result for the first cell. The CU 172 determines to activate the LTM DU configuration 1 or transmit the first LTM command, because the at least one measurement result indicates that signal strength or quality of the first cell is above a second predetermined threshold. The second predetermined threshold is different from the first predetermined threshold. In one implementation, the second predetermined threshold is larger than the first predetermined

threshold. In such an implementation, the at least one measurement report of the event 326 indicates that signal strength or quality of the first cell is suitable for communication with the UE 102. In another implementation, the second predetermined threshold is equal to the first predetermined threshold. In such an implementation, the at least one measurement report of the event 326 indicates that signal strength or quality of the first cell has been continuously above the second predetermined threshold or the first predetermined threshold. This also indicates that the first cell is suitable for communication with the UE 102. Thus, the CU 172 determines to activate the LTM DU configuration 1 in response to that signal strength or quality of the first cell is above the second predetermined threshold. In response to the determination, the CU 172 transmits 328 a fourth CU-to-DU message to the DU 174 to activate the LTM DU configuration 1 or trigger a serving cell change to the cell 1 for the UE 102. In some implementations, the CU 172 includes the ID 1 in the fourth CU-to-DU message. In other implementations, the CU 172 includes the cell index 1 in the fourth CU-to-DU message. In response to the fourth CU-to-DU message, the DU 174 transmits 330 the first LTM command to the UE 102 and optionally transmits a fourth DU-to-CU message to the CU 172. In some implementations, the CU 172 includes the cell index 1 in the fourth CU-to-DU message. Thus, the DU 174 can determine to activate the LTM DU configuration 1 in accordance with the cell index 1. In other implementations, the CU 172 can include the cell ID 1 in the fourth CU-to-DU message. Thus, the DU 174 determines to activate the LTM DU configuration 1 in accordance with the cell ID 1. In yet other implementations, the CU 172 can include the ID 1 in the fourth CU-to-DU message. Thus, the DU 174 can determine to activate the LTM DU configuration 1 in accordance with the ID 1. In some implementations, the fourth CU-to-DU message and fourth DU-to-CU message are a *UE Context Modification Request* message and a *UE Context Modification Response* message, respectively. In other implementations, the fourth CU-to-DU message and/or fourth DU-to-CU message are LTM-dedicated-type interface messages, e.g., F1 application protocol (F1AP) messages defined in a relevant 3GPP specification such as 38.473.

[0097] When or in response to determining to activate the LTM DU configuration 1 or transmit the first LTM command 330, the DU 174 might transmit 329 to the CU 172 a DU-to-CU message indicating LTM (being) executed. In some implementations, the DU 174 includes the cell ID 1 or the ID 1 (i.e., LTM ID) in the DU-to-CU message 329 to indicate that the DU 174 is to activate the LTM DU configuration 1 or trigger a fast serving cell

change. The DU can transmit the DU-to-CU message 329 to the CU 172 before or after transmitting the LTM command 330.

[0098] In some implementations, the first LTM command is a MAC CE included in a MAC PDU that the UE 102 receives from the DU 174 in the event 330. The MAC CE can be a dedicated MAC CE specifically defined for LTM in a relevant 3GPP specification such as TS 38.321. In one implementation, the DU 174 includes a subheader identifying the dedicated MAC CE in the MAC PDU and the UE 102 identifies the dedicated MAC CE in the MAC PDU in accordance with the subheader. The subheader can include a logical channel ID or extended logical channel ID defined in a 3GPP specification to identify the dedicated MAC CE. For example, the logical channel ID or extended logical channel ID are newly defined in 3GPP specification 38.321 v18.0.0 and/or later versions. In other implementations, the first LTM command is a DCI that the UE 102 receives on a PDCCH from the DU 174 in the event 330. The DU 174 generates a CRC for the DCI, scrambles the CRC with a first C-RNTI of the UE 102, and transmits the DCI and scrambled CRC on the PDCCH in the event 330. In one implementation, a format of the DCI can be an existing DCI format defined in a 3GPP specification (e.g., 38.212). In another implementation, the format of the DCI can be a dedicated DCI format specifically defined for the purposes of these procedures in a relevant 3GPP specification (e.g., TS 38.212).

[0099] In some implementations, the DU 174 does not perform security protection (e.g., integrity protection and/or encryption) on the first LTM command. This speeds up processing the first LTM command in the UE 102 because the UE 102 does not perform security check (e.g., decryption and/or integrity check) on the first LTM command.

[0100] In some implementations, after receiving the first LTM command, the UE 102 may transmit 331 an acknowledgement to the DU 174 on the cell 124A or cell 124D to indicate that the UE 102 receives the first LTM command. In some implementations, the acknowledgement is a HARQ ACK. In other implementations, the acknowledgement is a MAC CE. For example, the MAC CE is an existing MAC CE defined in 3GPP specification 38.321 v17.2.0 and/or later versions. In another example, the MAC CE is a dedicated MAC CE specifically defined for the purposes of these procedures in a relevant 3GPP specification such as 38.321. In yet other implementations, the acknowledgement is a PUCCH transmission.

[0101] In some implementations, the CU 172 transmits 316 the RRC reconfiguration message in response to the L3 measurement report 306 for the first cell. To configure the UE 102 to transmit the L3 measurement report 306, the CU 172 can transmit a first RRC reconfiguration message including the L3 measurement configuration (e.g., a *MeasConfig* IE) to the UE 102 before the event 306. In some implementations, the DU 174 transmits 330 the first LTM command in response to the L1 measurement report(s) 324 for the first cell. To configure the UE 102 to transmit the L1 or LTM-dedicated-type measurement report(s) 324, the CU 172 can transmit a second RRC reconfiguration message including the L1 or LTM-dedicated-type measurement configuration(s) to the UE 102. In some implementations, the first and second RRC reconfiguration messages can be the same message (i.e., the same instance). In other implementations, the first and second RRC reconfiguration messages are different messages. In some implementations, the second RRC reconfiguration message is the RRC reconfiguration message of the event 316. In other implementations, the second RRC reconfiguration message is different from the RRC reconfiguration message of the event 316.

[0102] After (e.g., in response to) receiving the first LTM command, the UE 102 identifies the LTM DU configuration 1 in accordance with the ID 1 and applies the LTM DU configuration 1. In some implementations, the UE 102 can perform 332 a random access procedure on the first cell with the DU 174 in response to applying the LTM DU configuration 1 or receiving the first LTM command. In some implementations, the UE 102 disconnects from the cell 124A after (e.g., in response to) receiving the first LTM command or after transmitting the acknowledgement. In other words, the UE 102 stops communicating on the cell 124A after (e.g., in response to) receiving 330 the first LTM command or transmitting 331 the acknowledgement. In such cases, the UE 102 performs 332 the random access procedure after disconnecting from the cell 124A. The UE 102 can determine whether to perform the random access procedure in accordance with the LTM DU configuration 1. In one implementation, if the LTM DU configuration 1 configures the UE 102 to perform a random access procedure, the UE 102 performs the random access procedure in the event 332. For example, the LTM DU configuration 1 includes a reconfiguration with sync configuration (e.g., *ReconfigurationWithSync* IE) to configure the UE 102 to perform a random access procedure. Otherwise, if the LTM DU configuration 1 does not configure the UE 102 to perform a random access procedure or configures the UE 102 to skip a random access procedure, the UE 102 refrains from performing a random access procedure with the

DU 174 upon receiving the first LTM command. In such a cases, the UE 102 skips the event 316. For example, if the LTM DU configuration 1 excludes a reconfiguration with sync configuration, the LTM DU configuration 1 configures the UE 102 not to perform a random access procedure. In some implementations, the random access procedure is a four-step random access procedure. In other implementations, the random access procedure is a two-step random access procedure. In some implementations, the random access procedure is a contention-free random access procedure. In other implementations, the random access procedure is a contention-based random access procedure.

[0103] In the case that the UE 102 performs 332 the random access procedure, the UE 102 communicates 336 with the DU 174 on the first cell using the LTM DU configuration 1 and/or reference LTM DU configuration and communicates with the CU 172 via the DU 174, after successfully completing the random access procedure. In such cases, the DU 174 communicates with the UE 102 on the first cell using the LTM DU configuration 1 in the event 332 and/or event 336. In some scenarios or implementations, the UE 102 communicates UL PDUs, DL PDUs, and/or physical layer signals (e.g., PUCCH transmissions and PDCCH transmissions) with the base station 104 in the event 336. In some implementations, the UE 102 determines that the UE 102 successfully completes the random access procedure when the UE 102 receives a contention resolution from the DU 174. In cases where the random access procedure is a four-step random access procedure, the UE 102 transmits a Message 3 including a UE identity to the DU 174 via the first cell in the random access procedure. In cases where the random access procedure is a two-step random access procedure, the UE 102 transmits a Message A including the UE identity to the DU 174 via the first cell in the random access procedure. In some implementations, if the LTM DU configuration 1 includes a second C-RNTI, the UE identity is the second C-RNTI of the UE 102. Otherwise, if the LTM DU configuration 1 does not include a C-RNTI, the UE identity is the first C-RNTI. In cases where the random access procedure is a contention free random access procedure, the UE 102 transmits the dedicated random access preamble to the DU 174 via the first cell. In such cases, the LTM DU configuration 1 includes the dedicated random access preamble.

[0104] The DU 174 identifies or determines that the UE 102 connects to the first cell upon receiving the UE identity or the dedicated preamble from the UE 102 in the random access procedure 332.

[0105] In the case that the UE 102 skips the random access procedure, the UE 102 directly communicates 336 with the DU 174 on the first cell in accordance with the LTM DU configuration 1 and communicates with the CU 172 via the DU 174, after (e.g., in response to) receiving the first LTM command. For example, the UE 102 directly communicates UL PDUs, DL PDUs, and/or physical layer signals (e.g., PUCCH transmissions and PDCCH transmissions) with the base station 104 in the event 336. In some implementations, the DU 174 can include, in the LTM DU configuration 1, configuration parameters configuring resources for the UE 102 to transmit the at least one PUCCH or PUSCH transmission, and the UE 102 transmits the at least one PUCCH or PUSCH transmission on the resources, using the configuration parameters, to indicate that the UE 102 connects to the first cell. In other implementations, the DU 174 can transmit to the UE 102 at least one DCI on a PDCCH on the first cell to command the UE 102 to transmit the at least one PUCCH or PUSCH transmission, after transmitting the first LTM command. The at least one DCI configures resources for the UE 102 to transmit the at least one PUCCH or PUSCH transmission, and the UE 102 transmits the at least one PUCCH or PUSCH transmission on the resources. The DU 174 identifies or determines that the UE 102 connects to the first cell upon receiving the PUCCH or PUSCH transmission. The DU 174 identifies or determines that the UE 102 connects to the first cell upon receiving the PUCCH or PUSCH transmission on the resources configured in the LTM DU configuration 1 or the at least one DCI.

[0106] In the case that the UE 102 receives the reference LTM DU configuration as described above, the UE 102 communicates 336 with and the DU 174 on the first cell in accordance with the LTM DU configuration 1 and at least a portion of the reference LTM DU configuration. In other words, the UE 102 communicates 336 with the DU 174 in accordance with configuration parameters in the LTM DU configuration 1 and the reference LTM DU configuration. Similarly, the DU 174 communicates 336 with the UE 102 on the first cell in accordance with the LTM DU configuration 1 and at least a portion of the reference LTM DU configuration. In other words, the DU 174 communicates 336 with the UE 102 in accordance with configuration parameters in the LTM DU configuration 1 and the reference LTM DU configuration.

[0107] In the case that the UE 102 receives neither the LTM CU configuration 1 nor a/the reference LTM CU configuration, the UE 102 communicates 336 with the CU 172 via the DU 174 using the serving CU configuration. Correspondingly, if the CU 172 neither transmits the LTM CU configuration 1 nor a/the reference CU configuration to the UE 102,

the CU 172 communicates 336 with the UE 102 via the DU 174 using the serving CU configuration. In the case that the UE 102 receives the LTM CU configuration 1 and the reference LTM CU configuration from the CU 172, the UE 102 communicates 336 with the CU 172 via the DU 174 using the LTM CU configuration 1 and (at least a portion of) the reference LTM CU configuration not augmented by the LTM CU configuration 1. In this case, the CU 172 communicates 336 with the UE 102 via the DU 174 using the LTM CU configuration 1 and (at least a portion of) the reference LTM CU configuration not augmented by the LTM CU configuration 1.

[0108] In the case that the UE 102 receives the LTM CU configuration 1 and does not receive the reference LTM CU configuration from the CU 172, the UE 102 communicates 336 with the CU 172 via the DU 174 using the LTM CU configuration 1. In this case, the CU 172 communicates 336 with the UE 102 via the DU 174 using the LTM CU configuration 1. If the LTM CU configuration 1 is a full configuration, the UE 102 and CU 172 communicates 336 with each other via the DU 174 using the LTM CU configuration 1 instead of the serving CU configuration. In some implementations, if the UE 102 does not receive a/the reference LTM CU configuration from the base station 104, the UE 102 determines that the LTM CU configuration 1 is a full configuration. Correspondingly, if the CU 172 determines to configure or configures the LTM CU configuration 1 as a full configuration, the CU 172 does not transmit a/the reference LTM CU configuration to the UE 102. In other implementations, the CU 172 includes a first indication (e.g., a field or IE) in the LTM CU configuration 1, the first container, the element 1 or the RRC reconfiguration message 316 to indicate that the LTM CU configuration 1 is a full configuration. If the LTM CU configuration 1 is a delta configuration to augment the serving CU configuration, the UE 102 and CU 172 communicates 336 with each other via the DU 174 using the LTM CU configuration 1 and at least a portion of the serving CU configuration not augmented by the LTM CU configuration 1. In some implementations, if the UE 102 does not receive a/the reference LTM CU configuration from the base station 104, the UE 102 determines that the LTM CU configuration 1 is a delta configuration to augment the serving CU configuration. Correspondingly, if the CU 172 determines to configure or configures the LTM CU configuration 1 as a delta configuration to augment the serving CU configuration, the CU 172 does not transmit a/the reference LTM CU configuration to the UE 102. In some implementations, the CU 172 indicates that the LTM CU configuration 1 is a delta configuration to augment to the serving CU configuration, by excluding the first indication in

the LTM CU configuration 1, the first container, the element 1 and/or the RRC reconfiguration message 316. Alternatively, the CU 172 includes a second indication (e.g., a field or IE) in the LTM CU configuration 1, the first container, the element 1 or the RRC reconfiguration message 316 to indicate that the LTM CU configuration 1 is a delta configuration to augment the serving CU configuration. In some implementations, the CU 172 indicates that the LTM CU configuration 1 is a full configuration, by excluding the second indication in the LTM CU configuration 1, the first container, the element 1 and/or the RRC reconfiguration message 316.

[0109] In the case that the UE 102 receives the reference LTM CU configuration and does not receive the LTM CU configuration 1 from the CU 172, the UE 102 communicates 336 with the CU 172 via the DU 174 using the reference LTM CU configuration. In this case, the CU 172 communicates 336 with the UE 102 via the DU 174 using the reference LTM CU configuration. If the reference LTM CU configuration is a full configuration, the UE 102 and CU 172 communicates 336 with each other via the DU 174 using the reference LTM CU configuration instead of the serving CU configuration. In some implementations, the UE 102 and CU 172 determine that the reference LTM CU configuration 1 is a full configuration as specified in a 3GPP specification (e.g., 3GPP specification 38.331 v18.0.0 or later version). In other implementations, the CU 172 includes a first indication (e.g., a field or IE) in the reference LTM CU configuration, the first container or the RRC reconfiguration message 316 to indicate that the reference LTM CU configuration is a full configuration. If the reference LTM CU configuration is a delta configuration to augment the serving CU configuration, the UE 102 and CU 172 communicates 336 with each other via the DU 174 using the reference LTM CU configuration and at least a portion of the serving CU configuration not augmented by the reference LTM CU configuration. In some implementations, the CU 172 indicates that the reference LTM CU configuration is a delta configuration to augment to the serving CU configuration, by excluding the first indication in the reference LTM CU configuration, the first container, the element 1 and/or the RRC reconfiguration message 316. Alternatively, the CU 172 includes a second indication (e.g., a field or IE) in the reference LTM CU configuration, the first container, the element 1 or the RRC reconfiguration message 316 to indicate that the reference LTM CU configuration is a delta configuration to augment the serving CU configuration. In some implementations, the CU 172 indicates that the reference LTM CU configuration is a full configuration, by excluding the second indication in the

reference LTM CU configuration, the first container, the element 1 and/or the RRC reconfiguration message 316.

[0110] In the case that the UE 102 neither receives the reference LTM CU configuration and nor the LTM CU configuration 1 from the CU 172, the UE 102 communicates 336 with the CU 172 via the DU 174 using the serving LTM CU configuration. In this case, the CU 172 communicates 336 with the UE 102 via the DU 174 using the serving LTM CU configuration.

[0111] In some implementations, the UE 102 transmits a RRC message (e.g., RRC reconfiguration complete message) to the CU 172 via the DU 174 and the first cell to indicate that the UE 102 applies the LTM DU configuration 1. In the case that the UE 102 performs the random access procedure 332, the UE 102 can include the RRC message in the Message 3 or Message A. Alternatively, the UE 102 transmits the RRC message after completing the random access procedure. In the case that the UE 102 skip the random access procedure 332, the UE 102 includes the RRC message in a PUSCH transmission of the at least one PUSCH transmission. In some implementations, if the UE 102 maintains communication on the cell 124A with the base station 104 (i.e., the UE 102 does not disconnect from the cell 124A), the UE 102 can transmit the RRC message to the base station 104 via the cell 124A. When the DU 174 receives the RRC message, the DU 174 transmits the RRC message to the CU 172.

[0112] In other implementations, the UE 102 refrains from transmitting the RRC message to the base station 104 in response to applying the LTM DU configuration 1 or receiving the first LTM command. In such cases, the UE 102 can include or transmit data in the Message 3, Message A or PUSCH transmission as described above. The UE 102 can generate a MAC PDU and/or a RLC PDU including the data and transmits or includes the MAC PDU and/or RLC PDU in the PUSCH transmission. For example, the data can be a PDCP PDU, a SDAP PDU, a LTE Positioning Protocol (LPP) PDU, a RRC PDU and/or a NAS PDU. The RRC PDU includes a UL-DCCH-Message excluding a RRC reconfiguration complete message. The NAS PDU includes a Mobility Management (MM) message or a Session Management (SM) message. The MM message can be a 5G MM message or a 6G MM message, and the SM message can be a 5G SM message or a 6G SM message. When the DU 174 receives the data, the DU 174 transmits the data to the CU 172.

[0113] When the DU 174 determines that the UE 102 successfully connects to the first cell in the event 332 or 336, the DU 174 can transmit 334 a DU-to-CU message (e.g., Access

Success message) to the CU 172 (e.g., a CP of the CU 172). In some implementations, the DU 174 can include the cell ID 1 of the first cell in the DU-to-CU message of the event 334. The cell ID can be a PCI or a CGI. Thus, the CU 172 determines that the UE 102 connects to the first cell upon receiving the DU-to-CU message of the event 334. When the DU 174 determines that the UE 102 successfully connect to the first cell in the event 332 or 336, the DU 174 can transmit a DL Data Delivery Status message or frame to the CU 172 (e.g., a UP of the CU 172). In some implementations, when or after the CU 172 receives the DU-to-CU message 329, the CU 172 might stop or suspend transmitting DL data for the UE 102 to the DU 174 until receiving the DU-to-CU message 334. The CU 172 might do so because the DU 174 cannot buffer DL data for the UE 102 during the LTM execution in the events 330 and/or 332. After receiving the DU-to-CU message 334, the CU 172 continues or resumes transmitting DL data for the UE 102 to the DU 174. In other implementations, when the CU 172 receives the DU-to-CU message 329, the CU 172 might continue transmitting DL data for the UE 102 to the DU 174. The CU 172 might do so because the DU 174 can buffer DL data for the UE 102 during the LTM execution in the events 330 and/or 332. When or after the DU 174 detects that UE 102 accesses the cell 1, the DU 174 transmits the DL data to the UE 102 via the cell 1.

[0114] In some implementations, when determining that the UE 102 connects to the first cell, transmitting 330 the first LTM command, or receiving 331 the acknowledgement, the DU 174 can stop communicating with the UE 102 on the cell 124A and/or release resources of the cell 124A configured for the UE 102.

[0115] In some implementations, the DU 174 can generate some or all of the LTM DU configuration 1 and/or LTM DU configuration(s) 2, ..., N as full configuration(s) to replace the serving DU configuration. If the LTM DU configuration 1 is a full configuration, the UE 102 and DU 174 communicate 336 with each other in accordance with the LTM DU configuration 1 instead of the serving DU configuration. In some implementations, the DU 174 includes an indication indicating that the LTM DU configuration 1 is a full configuration in the LTM DU configuration 1. In each of the LTM DU configuration(s) 2, ..., N, the DU 174 can include an indication to indicate that the corresponding DU configuration is a full configuration. Each of the indication(s) in the LTM DU configuration(s) 1, ..., N can be a field or IE (i.e., the same field or IE). In other implementations, the CU 172 can include, in the RRC reconfiguration message of the events 316, 318, a single indication indicating that the LTM DU configuration(s) 1 and/or 2, ..., N is/are full configuration(s). In the case of the

second container, the CU 172 can include, in the additional RRC reconfiguration message, a single indication indicating that the LTM DU configuration(s) 2, ..., N is/are full configuration(s). In yet other implementations, the CU 172 can include, in the first container, a single indication indicating that the LTM DU configuration(s) 1 and/or 2, ..., N is/are full configuration(s). In yet other implementations, for each of the LTM DU configuration(s) 2, ..., N, the CU 172 can include, in the first container, a particular indication indicating the corresponding LTM DU configuration is a full configuration. In the case of the second container, the CU 172 can include, in the second container, a single indication indicating that the LTM DU configuration(s) 2, ..., N is/are full configuration(s). In yet other implementations, the CU 172 can include, in the element 1, includes an indication indicating that the LTM DU configuration 1 is a full configuration. In each of the element(s) 2, ..., N, the CU 172 can include an indication indicating that the corresponding LTM DU configuration is a full configuration. The UE 102 can determine that the LTM DU configuration 1 and/or LTM DU configuration(s) 2, ..., N is/are full configuration(s) based on the indication(s) above. In some implementations, each of the indication(s) above is different from a *fullConfig* field defined in the current 3GPP specification. In some implementations, each of the indication(s) above is a *fullConfig* field defined in the current 3GPP specification. In the case that the LTM DU configuration 1 is a full configuration, the UE 102 in the event 336 does not apply the reference LTM DU configuration if received from the base station 104, e.g., in the RRC reconfiguration message 318. In such cases, the DU 174 might not include a/the reference LTM DU configuration in the first DU-to-CU message 310.

[0116] In other implementations, the DU 174 can generate the LTM DU configuration 1 and/or LTM DU configuration(s) 2, ..., N as delta configuration(s) that augment (a portion of) the reference LTM DU configuration. In other words, the DU 174 generates the LTM DU configuration(s) 1, ...N based on the reference LTM DU configuration. For example, if the LTM DU configuration 1 is a delta configuration, the UE 102 and DU 174 augment (the portion of) the reference LTM DU configuration with the LTM DU configuration 1. Thus, the UE 102 and DU 174 communicate 336 with each other in accordance with the LTM DU configuration 1 and unaugment portion of the reference LTM DU configuration. In some implementations, the LTM DU configuration(s) 1, and/or 2..., N, first container, second container or element(s) 1, ..., N exclude indication(s) indicating that the LTM DU configuration(s) 1, and/or 2..., N is/are full configuration(s) to indicate that the LTM DU

configuration(s) 1 and/or 2, ..., N is/are delta configuration(s). The UE 102 can determine that each of the LTM DU configuration(s) 1 and/or 2, ..., N is a delta configuration based on that the indication is excluded in the LTM DU configuration(s) 1 and/or 2, ..., N, first container, second container or element(s) 1 and/or 2, ..., N.

[0117] In some implementations, if the UE 102 does not receive a reference LTM DU configuration for the LTM DU configuration 1 and/or the LTM DU configuration(s) 2, ..., N, the UE 102 determines that the LTM DU configuration 1, and/or the LTM DU configuration(s) 2, ..., N are full configuration(s). Correspondingly, if the DU 174 does not obtain a reference LTM DU configuration for the UE 102 (i.e., the DU 174 does not generate a reference LTM DU configuration for the UE 102 and/or receive a reference LTM DU configuration for the UE 102 from the CU 172), the DU 174 generates the LTM DU configuration 1, and/or the LTM DU configuration(s) 2, ..., N as full configuration(s).

[0118] In other implementations, if the UE 102 does not receive a reference LTM DU configuration for the LTM DU configuration 1 and/or the LTM DU configuration(s) 2, ..., N, the UE 102 determines that the LTM DU configuration 1, and/or the LTM DU configuration(s) 2, ..., N are delta configuration(s) to augment the serving DU configuration. In such cases, the UE 102 communicates 336 with the DU 174 in accordance with the LTM DU configuration 1 and at least a portion of the serving DU configuration not augmented by LTM DU configuration 1. Correspondingly, if the DU 174 does not obtain a reference LTM DU configuration for the UE 102 (i.e., the DU 174 does not generate a reference LTM DU configuration for the UE 102 and/or receive a reference LTM DU configuration for the UE 102 from the CU 172), the DU 174 generates the LTM DU configuration 1, and/or the LTM DU configuration(s) 2, ..., N as delta configuration(s) to augment the serving DU configuration. In such cases, the DU 174 communicates 336 with the UE 102 in accordance with the LTM DU configuration 1 and the at least a portion of the serving DU configuration.

[0119] In some implementations, the UE 102 uses a UE MAC entity (e.g., MAC 204B) to communicate with a DU MAC entity (e.g., MAC 204B) of the DU 174 (e.g., the events 302, 304, 318, 320, 324, 330 and/or 331). In some implementations, the UE 102 resets the UE MAC entity, after or in response to receiving the first LTM command and before performing 332 the random access procedure or communicating 336 with the DU 174 via the first cell. In some implementations, the DU 174 resets the DU MAC entity after (e.g., in response to)

transmitting the first LTM command, receiving the acknowledgement 331 or determining that the UE 102 connects to the first cell.

[0120] In some implementations, when the UE 102 resets the UE MAC entity, the UE 102 performs at least one of the following actions for the UE MAC entity (i.e., UE MAC reset or full UE MAC reset):

- initialize B_j for configured logical channel(s) to zero;
- stop one or more timers;
- consider *timeAlignmentTimer*(s) as expired, if the UE 102 is configured to perform the random access procedure (e.g., the event 332) in the configuration (e.g., the configuration 1);
- set new data indicator(s) (NDI(s)) for UL HARQ process(es) to value 0;
- set NDI(s) for HARQ process ID(s) to value 0 for monitoring PDCCH in Sidelink resource allocation mode 1;
- flush Msg3 buffer;
- flush MSGA buffer;
- cancel, if any, triggered Scheduling Request procedure;
- cancel, if any, triggered Buffer Status Reporting procedure;
- cancel, if any, triggered Power Headroom Reporting procedure;
- cancel, if any, triggered consistent LBT failure;
- cancel, if any, triggered BFR;
- cancel, if any, triggered Sidelink Buffer Status Reporting procedure;
- cancel, if any, triggered Pre-emptive Buffer Status Reporting procedure;
- cancel, if any, triggered Timing Advance Reporting procedure;
- cancel, if any, triggered Recommended bit rate query procedure;
- cancel, if any, triggered configured uplink grant confirmation;
- cancel, if any, triggered configured sidelink grant confirmation;
- cancel, if any, triggered Desired Guard Symbol query;

- cancel, if any, triggered Positioning Measurement Gap Activation/Deactivation Request procedure;
- flush soft buffers for DL HARQ process(es);
- for each of the DL HARQ process(es), consider the next received transmission for a TB as the very first transmission;
- release, if any, Temporary C-RNTI;
- reset one or more counters (e.g., BFI_COUNTERs and/or LBT_COUNTERs).

[0121] In some implementations, when the DU 174 resets the DU MAC entity, the DU 174 performs at least one of the following actions for the DU MAC entity (i.e., DU MAC reset or full DU MAC reset):

- stop one or more timers;
- consider *timeAlignmentTimer(s)*, that the DU 174 starts and/or maintains for the UE 102, as expired, if the UE 102 is configured to perform the random access procedure (e.g., the event 332) in the configuration (e.g., the configuration 1);
- set NDI(s) for DL HARQ process(es) to value 0;
- flush soft buffers for UL HARQ process(es);
- for each of the UL HARQ process(es), consider the next received transmission for a TB as the very first transmission;
- reset one or more counters (e.g., BFI_COUNTERs and/or LBT_COUNTERs)

[0122] Depending on implementations, the UE 102 can determine to partially or fully reset the UE MAC entity. In some implementations, when the UE 102 resets the UE MAC entity as described above, the UE 102 fully resets the UE MAC entity (i.e., a full UE MAC reset). In the full UE MAC reset, the UE 102 performs some or all of the actions described above. In other implementations, when the UE 102 resets the UE MAC entity as described above, the UE 102 partially resets the UE MAC entity (i.e., a partial UE MAC reset). In the partial UE MAC reset, the UE 102 performs a subset or portion of the some or all of the actions in the full UE MAC reset.

[0123] In some implementations, the partial UE MAC reset includes at least one of the following actions:

- consider *timeAlignmentTimer*(s) of the UE 102 as expired, if the UE 102 is configured to perform the random access procedure (e.g., the event 332) in the configuration (e.g., the configuration 1);
- flush Msg3 buffer;
- flush MSGA buffer;
- release, if any, Temporary C-RNTI;
- reset one or more counters (e.g., BFI_COUNTERs and/or LBT_COUNTERs).

[0124] In some implementations, the partial UE MAC reset further includes at least one of the following actions:

- cancel, if any, triggered Scheduling Request procedure;
- cancel, if any, triggered Buffer Status Reporting procedure;
- cancel, if any, triggered Power Headroom Reporting procedure;
- cancel, if any, triggered consistent LBT failure;
- cancel, if any, triggered BFR;
- cancel, if any, triggered Sidelink Buffer Status Reporting procedure;
- cancel, if any, triggered Pre-emptive Buffer Status Reporting procedure;
- cancel, if any, triggered Timing Advance Reporting procedure;
- cancel, if any, triggered Recommended bit rate query procedure;
- cancel, if any, triggered configured uplink grant confirmation;
- cancel, if any, triggered configured sidelink grant confirmation;
- cancel, if any, triggered Desired Guard Symbol query;
- cancel, if any, triggered Positioning Measurement Gap Activation/Deactivation Request procedure;

[0125] In some implementations, the partial UE MAC reset further includes at least one of the following actions:

- stop a first portion of the one or more timers and retain the rest of the one or more timers;

- set new data indicator(s) (NDI(s)) for UL HARQ process(es) to value 0;
- set NDI(s) for HARQ process ID(s) to value 0 for monitoring PDCCH in Sidelink resource allocation mode 1;
- flush soft buffers for DL HARQ process(es);
- for each of the DL HARQ process(es), consider the next received transmission for a TB as the very first transmission;

[0126] Depending on implementations, the DU 174 can determine to partially or fully reset the DU MAC entity. In some implementations, when the DU 174 resets the DU MAC entity as described above, the DU 174 fully resets the DU MAC entity (i.e., a full DU MAC reset). In the full DU MAC reset, the DU 174 performs some or all of the actions described above. In other implementations, when the DU 174 resets the DU MAC entity as described above, the DU 174 partially resets the DU MAC entity (i.e., a partial DU MAC reset). In the partial DU MAC reset, the DU 174 performs a subset or portion of the some or all of the actions in the full DU MAC reset.

[0127] In some implementations, the partial DU MAC reset includes at least one of the following actions in the partial MAC reset:

- consider *timeAlignmentTimer(s)*, that the DU 174 starts and/or maintains for the UE 102, as expired, if the UE 102 is configured to perform the random access procedure (e.g., the event 332) in the configuration (e.g., the configuration 1);
- reset one or more counters (e.g., BFI_COUNTERs and/or LBT_COUNTERs)

[0128] In some implementations, when the partial DU MAC reset includes at least one of the following actions for the MAC entity (i.e., DU MAC reset):

- stop a first portion of the one or more timers and retain the rest of the one or more timers;
- set NDI(s) for DL HARQ process(es) to value 0;
- flush soft buffers for UL HARQ process(es);
- for each of the UL HARQ process(es), consider the next received transmission for a TB as the very first transmission;
- reset one or more counters (e.g., BFI_COUNTERs and/or LBT_COUNTERs)

[0129] In other implementations, the UE 102 refrains from resetting the UE MAC entity in response to receiving the first LTM command. Similarly, the DU 174 refrains from resetting the DU MAC entity after (e.g., in response to) transmitting the first LTM command, receiving the acknowledgement 331 or determining that the UE 102 connects to the first cell. In other words, the UE 102 communicates with the DU 174 on the first cell using the UE MAC entity (not reset). Similarly, the DU 174 communicates with the UE 102 using the DU MAC entity (not reset) on the first cell during or after the random access procedure 332 or after determining that the UE 102 connects to the first cell.

[0130] In some implementations, the UE 102 uses at least one UE RLC entity (e.g., RLC 206B) to communicate RLC PDUs with at least one DU RLC entity (e.g., RLC 206B) of the DU 174 (e.g., the events 302, 304, 318, 320, 324, 330 and/or 331). In some implementations, the UE 102 reestablishes some or all of the at least one UE RLC entity, after or in response to receiving the first LTM command and before performing 332 the random access procedure or communicating 336 with the DU 174 via the first cell. In some implementations, the DU 174 reestablishes some or all of the at least one DU RLC entity after (e.g., in response to) transmitting the first LTM command, receiving the acknowledgement 331 or determining that the UE 102 connects to the first cell.

[0131] In some implementations, the LTM DU configuration 1 may or may not include one or more RLC reestablishment indications (e.g., *reestablishRLC* field(s)) configuring the UE 102 to reestablish some or all of the at least one UE RLC entity. If the LTM DU configuration 1 includes the a RLC reestablishment indication configuring the UE 102 to reestablish a first UE RLC entity, of the at least one UE RLC entity, that the UE 102 uses to communicate RLC PDU(s) with the DU 174, the UE 102 reestablishes the first UE RLC entity in response to the RLC reestablishment indication and the first LTM command. In some implementations, the UE 102 can reestablish the first UE RLC entity before performing 332 the random access procedure or communicating 336 with the DU 174 via the first cell. In other implementations, the UE 102 can reestablish the first UE RLC entity while or after performing 332 the random access procedure. Otherwise if the LTM DU configuration 1 does not include the RLC reestablishment indication, the UE 102 refrains from reestablishing the first UE RLC entity in response to the first LTM command.

[0132] In some implementations, when the UE 102 reestablishes the first UE RLC entity, the UE 102 performs at least one of the following actions for the first UE RLC entity:

- discard RLC SDU(s), RLC SDU segment(s), and RLC PDU(s), if any;
- stop and reset timer(s), if running;
- reset state variables to initial values.

In some implementations, the state variables and timer(s) are defined in 3GPP specification 38.322.

[0133] Otherwise, if the LTM DU configuration 1 does not include the RLC reestablishment indication for the first UE RLC entity, the UE 102 refrains from reestablishing the first UE RLC entity upon or when receiving the first LTM command. In other words, the UE 102 refrains from performing the actions for reestablishing the first UE RLC entity of the UE 102 upon or when receiving the first LTM command. In some implementations, if the LTM DU configuration 1 or element 1 does not include the RLC reestablishment indication and includes an indication indicating that the configuration 1 is a full configuration, the UE 102 can reestablish the first UE RLC entity of the UE 102 upon or when receiving the first LTM command. Otherwise, if the LTM DU configuration 1 or element 1 does not include the RLC reestablishment indication and the indication indicating that the configuration 1 is a full configuration, the UE 102 refrains from reestablishing the first UE RLC entity upon or when receiving the first LTM command.

[0134] Similarly, the DU 174 reestablishes some or all of at least one DU RLC entity (e.g., NR RLC 206B) that the DU 174 uses to communicate with the at least one UE RLC entity of the UE 102 (e.g., the events 302, 304, 318, 320, 324, 330 and/or 331) in response to the RLC reestablishment indication. In some implementations, the DU 174 reestablishes a first DU RLC entity of the at least one DU RLC entity after transmitting the first LTM command, receiving an acknowledgement for the first LTM command from the UE 102, or determining that the UE 102 connects to the first cell. In some implementations, the acknowledgement is a HARQ ACK. In other implementations, the acknowledgement is a MAC CE. In yet other implementations, the acknowledgement is a PUCCH transmission. In some implementations, when the base station 104 reestablishes the first DU RLC entity, the DU 174 performs at least one of the following actions for the first DU RLC entity:

- discard RLC SDU(s), RLC SDU segment(s), and RLC PDU(s), if any;
- stop and reset timer(s), if running;
- reset state variables to initial values.

In some implementations, the state variables and timer(s) are defined in 3GPP specification 38.322.

[0135] In other implementations, the UE 102 refrains from reestablishing some or all of the at least one UE RLC entity in response to receiving the first LTM command. Similarly, the DU 174 refrains from reestablishing some or more of the at least one DU RLC entity after (e.g., in response to) transmitting the first LTM command, receiving the acknowledgement 331 or determining that the UE 102 connects to the first cell. In other words, the UE 102 communicates with the DU 174 on the first cell using the some or all of the at least one UE RLC entity (not reestablished). For example, the some or all of the at least one UE RLC entity includes the first UE RLC entity and/or a second UE RLC entity. Similarly, the DU 174 communicates with the UE 102 using the some or all of the at least one DU RLC entity (not reestablished) on the first cell during or after the random access procedure 332 or after determining that the UE 102 connects to the first cell. For example, the some or all of the at least one DU RLC entity includes the first DU RLC entity and/or a second DU RLC entity.

[0136] In some implementations, the UE 102 uses at least one UE PDCP entity (e.g., PDCP 210) to communicate UL PDCP PDUs and/or DL PDCP PDUs with at least one CU PDCP entity (e.g., PDCP 210) of the CU 172 in the event 302. In some implementations, the UE 102 performs a PDCP recovery procedure for some or all of the at least one UE PDCP entity, after or in response to receiving the first LTM command. For example, the UE 102 performs a PDCP recovery procedure for a first UE PDCP entity of the at least one UE PDCP entity, after or in response to receiving the first LTM command. In the PDCP recovery procedure, the UE 102 may or may not reestablish the first UE PDCP entity. After or in response to performing the PDCP recovery procedure, the UE 102 can retransmit at least a portion of the UL PDCP PDUs to the CU 172 via the DU 174 and the first cell in the event 336. Similarly, the CU 172 performs a PDCP recovery procedure for some or all of the at least one CU PDCP entity after or in response to transmitting the first LTM command. For example, the CU 172 performs a PDCP recovery procedure for a first CU PDCP entity of the at least one CU PDCP entity, after or in response to transmitting the first LTM command. In some implementations, the CU 172 performs the PDCP recovery procedure for the first CU PDCP entity in response to receiving the DU-to-CU message 329 or 334. In other implementations, the CU 172 performs the PDCP recovery procedure for the first CU PDCP entity in response to receiving the DL Data Delivery Status message. In the PDCP recovery procedure, the CU 172 may or may not reestablish the first CU PDCP entity. After or in

response to performing the PDCP recovery procedure, the CU 172 can retransmit at least a portion of the DL PDCP PDUs to the UE 102 via the DU 174 and the first cell in the event 336.

[0137] In other implementations, the UE 102 refrains from reestablishing some or all of the at least one UE PDCP entity in response to receiving the first LTM command. For example, the some or all of the at least one UE PDCP entity includes the first UE PDCP entity and/or a second UE PDCP entity. Similarly, the CU 172 refrains from reestablishing some or more of the at least one CU PDCP entity, after (e.g., in response to) receiving the DU-to-CU message 329 or 340 or after (e.g., in response to) receiving the DL Data Delivery Status message. In other words, the UE 102 communicates with the CU 172 via the DU 174 and the first cell using the some or all of the at least one UE PDCP entity (not reestablished). For example, the some or all of the at least one UE PDCP entity includes the first UE PDCP entity and/or a second UE PDCP entity. Similarly, the CU 172 communicates with the UE 102 using the some or all of the at least one CU PDCP entity (not reestablished) via the DU 174 and the first cell. For example, the some or all of the at least one CU PDCP entity includes the first CU PDCP entity and/or a second CU PDCP entity.

[0138] In some implementations, after determining that the UE 102 connects to the first cell, the CU 172 can transmit 338 a CU-to-DU message (e.g., a *UE Context Modification Request* message) to the DU 174 to indicate the DU 174 to stop communicating with the UE 102 and/or to release or suspend resources, of the cell 124A, configured for the UE 102. In response, the DU 174 can stop communicating on the cell 124A with the UE 102 and/or release or suspend resources, of the cell 124A, configured for the UE 102, and transmit 340 a DU-to-CU message (e.g., a *UE Context Modification Response* message) to the CU-172. The events 338 (optional) and 340 (optional) are collectively referred to in Fig. 3 as a resource release procedure 396.

[0139] After or while communicating with the DU 174 on the first cell, events 344, 346, 348, 350, 351, 352, 354 and/or 356 might occur, similar to the events 324, 326, 328, 330, 331, 332, 334 and/or 336, respectively. The UE 102 transmits 344 at least one measurement report to the DU 174. The at least one measurement report includes at least one measurement result for a second cell (i.e., the cell 2). The at least one measurement result indicates that the second cell is suitable for communication with UE 102 and/or the first cell is not suitable for communication with the UE 102. After (e.g., in response to) receiving the at least one

measurement report, the DU 174 determines to activate the LTM DU configuration 2 and generates a second LTM command to activate the LTM DU configuration 2 (i.e., the second LTM command commands the UE 102 to apply the LTM DU configuration 2). The DU 174 then transmits 350 the second LTM command to the UE on the first cell to the UE 102.

[0140] When or in response to determining to activate the LTM DU configuration 2 or transmit the second LTM command, the DU 174 might transmit 349 to the CU 172 a DU-to-CU message indicating LTM (being) executed. In some implementations, the DU 174 includes the cell ID 2 or the ID 2 (i.e., LTM ID) in the DU-to-CU message 349 to indicate that the DU 174 is to activate the LTM DU configuration 2. The DU can transmit the DU-to-CU message 349 to the CU 172 before or after transmitting the LTM command 350.

[0141] The descriptions for the events 324, 326, 328, 330, 331, 332, 334 and/or 336 can be applied to the events 344, 346, 348, 350, 351, 352, 354 and/or 356 with simple changes. For example, “cell 124A”, “first LTM command”, “first cell”, “ID 1”, “LTM DU configuration 1” and/or “LTM CU configuration 1” are replaced with “first cell”, “second LTM command” and “second cell”, “ID 2”, “LTM DU configuration 2” and/or “LTM CU configuration 2”, respectively.

[0142] The events 344, 346, 348, 350, 351, 352, 354 are collectively referred to in Fig. 3 as a LTM execution procedure 398. The events 304, 306, 390, 392, 394, 324, 326, 328, 329, 330, 331, 332, 334, 336, 396, 398, 356 are collectively referred to in Fig. 3 as a LTM DU configuration and/or activation procedure 380.

[0143] Referring next to Fig. 4, in a scenario 400, the base station 104 includes a CU 172, a source DU (S-DU) 174A and a target DU (T-DU) 174B. The S-DU 174A operates the cell 124A and optionally additional cell(s), while the T-DU 174B operates a first cell (e.g., cell 124C). The scenario 400 is similar to the scenario 300. Thus, the descriptions for the scenario 300 can generally apply to the scenario 400. The differences between the scenarios 300 and 400 are described below.

[0144] Initially, the UE 102 communicates 402 with the S-DU 174A on cell 124A using a serving DU configuration and communicates with the CU 172 via the S-DU 174A. During the communication 402, the UE 102 transmits 404, 406 at least one measurement report (e.g., L3 measurement report(s)) to the CU 172 via the S-DU 174A. Based on the at least one measurement report, the CU 172 determines to prepare cell(s) 1, ..., N (operated by the T-DU 174B) for LTM for the UE 102, where N is a positive integer larger than 0 or 1. The cell(s)

1, ..., N are identified by cell ID(s) 1, ..., N, respectively. In response to the determination, the CU 172 performs 490 a LTM preparation procedure with the T-DU 174B to (request the T-DU 174B to) prepare cell(s) 1, ..., N for LTM for the UE 102. N can be a positive integer larger than zero or 1. In the LTM preparation procedure 490, the CU 172 transmits a CU-to-DU message including the cell ID(s) 1, ..., N to the T-DU 174B to request the T-DU 174B to prepare the cell(s) 1, ..., N for LTM for the UE 102, similar to the event 308. In response, the T-DU 174B transmits a DU-to-DU message including the LTM DU configuration(s) 1, ..., N to the CU 172, similar to the event 310. The LTM DU configuration(s) 1, ..., N configures the cell(s) 1, ..., N for LTM, respectively. In details, the LTM DU configuration(s) 1, ..., N include configuration parameters for communication on the cell(s) 1, ..., N, respectively. In some implementations, the CU-to-DU message and DU-to-CU message in the procedure 490 are UE Context Setup Request message and UE Context Setup Response message, respectively. The CU 172 then transmits the LTM DU configuration(s) 1, ..., N in a RRC reconfiguration message in a LTM configuration delivery procedure 494, similar to the LTM configuration delivery procedure 394. In some implementations, the T-DU 174B can include cell index(es) 1, ..., N in the LTM DU configuration(s) 1, ..., N, respectively. In some implementations, the CU 172 can set the cell index(es) 1, ..., N to different values and include the cell index(es) 1, ..., N in the CU-to-DU message of the procedure 490.

[0145] After performing the LTM preparation procedure 490, the CU 172 might perform an additional LTM preparation procedure(s) with the T-DU 174B to prepare cell(s) N+1, ..., N+M for LTM for the UE 102. M is a positive integer larger than zero. The CU 172 might determine to do so based on one or more measurement reports received from the UE 102 via the S-DU 174A, similar to the events 404, 406. In the additional LTM preparation procedure, the CU 172 transmits a CU-to-DU message including cell ID(s) N+1, ..., N+M to the T-DU 174B to request the T-DU 174B to prepare the cell(s) N+1, ..., N+M for LTM for the UE 102. The cell ID(s) N+1, ..., N+M identifies the cell ID(s) N+1, ..., N+M, respectively. In response to the CU-to-DU message, the T-DU 174B transmits a DU-to-DU message including the LTM DU configuration(s) N+1, ..., N+M to the CU 172. The LTM DU configuration(s) N+1, ..., N+M configures the cell(s) N+1, ..., N+M for LTM, respectively. In details, the LTM DU configuration(s) N+1, ..., N+M include configuration parameters for communication on the cell(s) N+1, ..., N+M, respectively. The CU 172 then transmits the LTM DU configuration(s) N+1, ..., N+M in a RRC reconfiguration message in an additional

LTM configuration delivery procedure, similar to the LTM configuration delivery procedure 394 or 494.

[0146] In some implementations, the LTM preparation procedure 490 is a UE Context Setup procedure and the additional LTM preparation procedure is a UE Context Modification procedure.

[0147] In some implementations, the CU 172 and S-DU 174A might perform the procedure 380 with the UE 102, as described for Fig. 3. In the procedure 380, the CU 172 and S-DU 174A performs the procedure(s) 390 and/or 392 to prepare cell(s) of the S-DU 174A for LTM for the UE 102. Note, the value N in the procedure 380 or described for Fig. 3 can be the same as or different from the value N described for Fig. 4. In the procedure 390, the CU 172 might receive the first DU-to-CU message including the reference LTM DU configuration from the S-DU 174A in the event 310. In other implementations, the CU 172 and S-DU 174A does not perform the procedure 380 with the UE 102. In such cases, the CU 172 can perform 488 a reference LTM DU configuration query procedure with the S-DU 174A to obtain a reference LTM DU configuration. In the procedure 488, the CU 172 transmits 460 a CU-to-DU message to the S-DU 174A to request or query a reference LTM DU configuration. In some implementations, the CU 172 can include an indication in the CU-to-DU message to request or query a reference LTM DU configuration. In response to the indication or CU-to-DU message 460, the S-DU 174A transmits 462 a DU-to-CU message including a reference LTM DU configuration to the CU 172. In some implementations, the indication is a reference LTM DU configuration query indication. In other implementations, the indication is a LTM indication, and the CU 172 might include a query indication (e.g., GNB-DU Configuration Query IE) in the CU-to-DU message. After receiving the reference LTM DU configuration (i.e., either in the procedure 390 or in the procedure 488), the CU 172 includes the reference LTM DU configuration (received from the S-DU 174A) in the CU-to-DU message in the LTM preparation procedure 490. The T-DU 174B generates the LTM DU configuration(s) 1, ..., N based on the reference LTM DU configuration received from the CU 172. In such cases, the T-DU 174B does not include a reference LTM DU configuration in the DU-to-CU message in the procedure 490. In the case of the additional LTM preparation procedure, the T-DU 174B does not include a reference LTM DU configuration in the DU-to-CU message in the additional LTM preparation procedure. The CU 172 might not include the reference LTM DU configuration in CU-to-DU message in the additional LTM preparation procedure with the T-DU 174B. In the case of the additional LTM

preparation procedure, the T-DU 174B generates the LTM DU configuration(s) N+1, ..., N+M based on the reference LTM DU configuration received from the CU 172.

[0148] In some implementations, the CU 172 does not provide a reference LTM DU configuration to the T-DU 174B in the LTM preparation procedure 490. In such cases, the T-DU 174B generates a reference LTM DU configuration and generates the LTM DU configuration(s) 1, ..., N based on the reference LTM DU configuration. In such cases, the T-DU 174B includes the reference LTM DU configuration in the DU-to-CU message in the procedure 490. The CU 172 transmits the reference LTM DU configuration in the RRC reconfiguration message in the procedure 490. In the case of the additional LTM preparation procedure, the T-DU 174B generates the LTM DU configuration(s) N+1, ..., N+M based on the reference LTM DU configuration. In this case, the T-DU 174B might not include the reference LTM DU configuration in the DU-to-CU message in the additional LTM preparation procedure. In some implementations, the reference LTM DU configuration generated by the T-DU 174B is different from the reference LTM DU configuration generated by the S-DU 174A. In other implementations, the reference LTM DU configuration generated by the T-DU 174B is the same as the reference LTM DU configuration generated by the S-DU 174A.

[0149] In some implementations, the CU 172 assigns ID(s) 1, ..., N identifying the LTM DU configuration(s) 1, ..., N (received from the T-DU 174B), respectively, and performs the procedure 492 with the T-DU 174B to provide the ID(s) 1, ..., N and/or cell ID(s) 1, ..., N to the T-DU 174B, similar to the procedure 392. Thus, the T-DU 174B associates the ID(s) 1, ..., N with the LTM DU configuration(s) 1, ..., N and/or the cell ID(s) 1, ..., N, respectively. In other implementations, the T-DU 174B assigns ID(s) 1, ..., N identifying the LTM DU configuration(s) 1, ..., N (generated by the T-DU 174B), respectively and includes the ID(s) 1, ..., N in the DU-to-CU message of the procedure 490, similar to the event 310. In some implementations, the CU 172 assigns ID(s) N+1, ..., N+M identifying the LTM DU configuration(s) N+1, ..., N+M, respectively, and performs a procedure (similar to the procedure 492) with the T-DU 174B to provide the ID(s) N+1, ..., N+M and/or cell ID(s) N+1, ..., N+M to the T-DU 174B, similar to the procedure 392. Thus, the T-DU 174B associates the ID(s) N+1, ..., N+M with the LTM DU configuration(s) N+1, ..., N+M and/or the cell ID(s) N+1, ..., N+M, respectively. In other implementations, the T-DU 174B assigns ID(s) N+1, ..., N+M identifying the LTM DU configuration(s) N+1, ..., N+M, respectively

and includes the ID(s) 1, ..., N in the DU-to-CU message of the additional LTM preparation procedure, similar to the event 310.

[0150] In some implementations, the CU 172 transmits 412 a CU-to-DU message including the ID(s) 1, ..., N to the S-DU 174A and receives 414 a DU-to-CU message from the S-DU 174A in response. The CU-to-DU message 412 and DU-to-CU message 414 are collectively referred to in Fig. 4 as a LTM ID transfer procedure 493 or a LTM cell index transfer procedure 493. In some implementations, the message 412 and message 414 can be UE Context Modification Request message and UE Context Modification Response message, respectively. In some implementations, the CU 172 includes the LTM DU configuration(s) 1, ..., N and/or cell ID(s) 1, ..., N in the CU-to-DU message 412. In one implementation, the CU 172 includes the ID(s) 1, ..., N in the CU-to-DU message 412. In another implementation, the CU 172 includes the cell index(es) 1, ..., N in the CU-to-DU message 412. In some alternative implementations, the CU 172 can perform multiple LTM ID transfer procedures to transmit the ID(s) 1, ..., N, cell ID(s) 1, ..., N and/or LTM DU configuration(s) 1, ..., N to the S-DU 174A. In each of the procedures, the CU 172 includes particular portion of the ID(s) 1, ..., N, cell ID(s) 1, ..., N and/or LTM DU configuration(s) 1, ..., N in a CU-to-DU message similar to the message 412. Thus, the S-DU 174A associates the ID(s) 1, ..., N with the LTM DU configuration(s) 1, ..., N and/or the cell ID(s) 1, ..., N, respectively. In other alternative implementations, the CU 172 can perform multiple LTM cell index transfer procedures to transmit the cell index(es) 1, ..., N, cell ID(s) 1, ..., N and/or LTM DU configuration(s) 1, ..., N to the S-DU 174A. In each of the procedures, the CU 172 includes particular portion of the cell index(es) 1, ..., N, cell ID(s) 1, ..., N and/or LTM DU configuration(s) 1, ..., N in a CU-to-DU message similar to the message 412. Thus, the S-DU 174A associates the cell index(es) 1, ..., N with the LTM DU configuration(s) 1, ..., N and/or the cell ID(s) 1, ..., N, respectively.

[0151] In some implementations, the CU 172 transmits a CU-to-DU message including the ID(s) N+1, ..., N+M to the S-DU 174A and receives a DU-to-CU message from the S-DU 174A in response, similar to the CU-to-DU message 412 and the DU-to-CU message 414, respectively. In some implementations, the CU 172 includes the LTM DU configuration(s) N+1, ..., N+M and/or cell ID(s) N+1, ..., N+M in the CU-to-DU message. In some alternative implementations, the CU 172 can perform multiple LTM ID transfer procedures to transmit the ID(s) N+1, ..., N+M, cell ID(s) N+1, ..., N+M and/or LTM DU configuration(s) N+1, ..., N+M to the S-DU 174A. In each of the procedures, the CU 172 includes particular

portion of the ID(s) N+1, ..., N+M, cell ID(s) N+1, ..., N+M and/or LTM DU configuration(s) 1, ..., N in a CU-to-DU message similar to the message 412. Thus, the S-DU 174A associates the ID(s) N+1, ..., N+M with the LTM DU configuration(s) N+1, ..., N+M and/or the cell ID(s) N+1, ..., N+M, respectively.

[0152] In some implementations, in the case that the CU 172 and S-DU 174A perform the procedure 380 with the UE 102, value(s) of the ID(s) 1, ..., N of the procedure 380 are different from value(s) of the ID(s) 1, ..., N, and the ID(s) N+1, ..., N+M described for the scenario 400. In some implementations, in the case that the CU 172 and S-DU 174A perform the procedure 380 with the UE 102, value(s) of the cell ID(s) 1, ..., N of the procedure 380 are different from value(s) of the cell ID(s) 1, ..., N, and the cell ID(s) N+1, ..., N+M described for the scenario 400. In some implementations, in the case that the CU 172 and S-DU 174A perform the procedure 380 with the UE 102, value(s) of the cell index(es) 1, ..., N of the procedure 380 are different from value(s) of the cell index(es) 1, ..., N, and the cell index(es) N+1, ..., N+M described for the scenario 400.

[0153] At a later time, the UE 102 might transmit 424 at least one measurement report to the S-DU 174A, similar to the event 324. The at least one measurement report (e.g., L1 measurement report(s)) includes an event ID, first measurement result(s) for the cell 1 of the T-DU 174B, and/or includes second measurement result(s) for the cell 124A. In some implementations, the first measurement result(s) can be or include RSRP, RSRQ and/or SINR that the UE 102 obtains from reference signal(s) transmitted on the cell 1. Likewise, the second measurement result(s) can be or include RSRP, RSRQ and/or SINR that the UE 102 obtains from reference signal(s) transmitted on the cell 124A. In some implementations, the event ID, RSRP, RSRQ and/or SINR are L1-event ID, L1-RSRP, L1-RSRQ and/or L1-SINR, respectively. Based on the first measurement result(s) and/or second measurement result(s), the S-DU 174A might transmit 430 a first LTM command (i.e., LTM command 1) including the ID 1 to the UE 102 to order the UE 102 to perform a serving cell change to the cell 1 of the T-DU 174B. In some implementations, the first LTM command includes the ID 1. In other implementations, the first LTM command includes the cell index 1. When the UE 102 receives the first LTM command, the UE 102 performs a serving cell change to the cell 1 from a serving cell in accordance with the LTM DU configuration 1. After (e.g., in response to) receiving the first LTM command, the UE 102 might or might not perform 432 a random access procedure with the T-DU 174B, similar to the event 332. After (e.g., in response to) receiving the first LTM command or completing the random access procedure 432, the UE

102 might communicate 436 with the T-DU 174B on the first cell using the LTM DU configuration 1 and/or reference LTM DU configuration and communicates with the CU 172 via the T-DU 174B, similar to the event 336. If a serving cell change occurs in the procedure 380, the serving cell can be the cell 1 or cell 2 of the S-DU 174A. Otherwise, if no serving cell change occurs in the procedure 380 or the procedure 380 is not performed, the serving cell is the cell 124A. If the first LTM command includes the ID 1, the UE 102 identifies the LTM DU configuration 1 and/or cell ID 1 (i.e., the cell 1), based on the ID 1, as described for Fig. 3. If the first LTM command includes the cell index 1, the UE 102 identifies the LTM DU configuration 1, cell ID 1 (i.e., the cell 1) and/or LTM ID 1, based on the cell index 1, as described for Fig. 3. The UE 102 applies the LTM DU configuration 1 to communicate with the T-DU 174B, after (e.g., in response to) receiving the first LTM command or successfully accessing the cell 1.

[0154] When or in response to determining to activate the LTM DU configuration 1 or transmit the first LTM command 430, the S-DU 174A might transmit 429 to the CU 172 a DU-to-CU message indicating LTM (being) executed. In some implementations, the S-DU 174A includes the cell ID 1 or the ID 1 (i.e., LTM ID) in the DU-to-CU message 429 to indicate that the S-DU 174A is to activate the LTM DU configuration 1 or trigger a fast serving cell change. The S-DU 174A can transmit the DU-to-CU message 429 to the CU 172 before or after transmitting the LTM command 430. In some implementations, when or after the CU 172 receives the DU-to-CU message 429, the CU 172 might stop or suspend transmitting DL data for the UE 102 to the S-DU 174A until receiving the DU-to-CU message 434. After receiving the DU-to-CU message 434, the CU 172 starts, continues or resumes transmitting DL data for the UE 102 to the T-DU 174B. When or after the T-DU 174B detects that UE 102 accesses the cell 1, the T-DU 174B transmits the DL data to the UE 102 via the cell 1.

[0155] The resource release procedure 496 can be similar to the procedure 396. Alternatively, in the resource release procedure 496, the CU 172 can transmit a CU-to-DU message (e.g., a *UE Context Release Command* message) to the S-DU 174A to release a UE context of the UE 102. In response, the S-DU 174A releases a UE context of the UE 102 and transmits 440 a DU-to-CU message (e.g., a *UE Context Release Complete* message) to the CU-172.

[0156] The events 380, 404, 406, 490, 492, 494, 494, 424, 426, 428, 429, 430, 431, 432, 434, 436, 496, 498, 456 are collectively referred to in Fig. 4 as a LTM configuration and/or activation procedure 480.

[0157] Referring next to Fig. 5A, in a scenario 500A, the base station 106 operates as an MN, and the base station 104 operates as an SN. The SN 104 includes a CU 172 and a DU 174. The scenario 500A is similar to the scenario 300, except that the scenario 500A is a DC scenario and the scenario 300 is a single connectivity (SC) scenario. The MN 106 can include a CU and a DU similar to the base station 104 of Fig. 3.

[0158] Initially, the UE 102 in DC communicates with the MN 106 and with SN 104. In the event 502, the UE 102 communicates with the DU 174 on cell 124A using a serving DU configuration and communicates with the CU 172 via the DU 174 using a serving CU configuration, similar to the event 302. In some alternative implementations, the UE 102 does not communicate with the CU 172 via the DU 174 in the event 302. In some implementations, the UE 102 in DC can communicate 502 UL PDUs and/or DL PDUs with the MN 106 and/or SN 104 via radio bearers which can include SRBs and/or DRB(s). The MN 106 and/or the SN 104 can configure the radio bearers to the UE 102. The UE 102 in DC communicates 502 UL PDUs and/or DL PDUs with the SN 104 on an SCG (i.e., SCG radio resources) that the SN 104 configures for communication with the UE 102. The UE 102 in DC communicates UL PDUs and/or DL PDUs with the MN 106 on an MCG (i.e., MCG radio resources) in accordance with a MN configuration (i.e., MCG configuration). In some implementations, the serving DU configuration is a SN configuration (i.e., SCG configuration). In the MN configuration, the MN 106 configures the MCG which includes at least one serving cell (e.g., the cell 126 and/or other cell(s)) operated by the MN 106. In the serving DU configuration, the SN 106A configures the SCG which includes at least one serving cell (e.g., the cell 124A and/or other cell(s)) operated by the SN 104. In some implementations, the MN configuration includes multiple configuration parameters and the UE 102 receives the configuration parameters in one or more RRC messages from the MN 106. As described for Fig. 3, the serving DU configuration includes multiple configuration parameters. In some implementations, the UE 102 receives these configuration parameters in one or more RRC messages from the SN 104, e.g., via the MN 106 and/or on an SRB (e.g., SRB3) that the MN 106 or SN 104 configures to exchange RRC messages between the UE 102 and the SN 104.

[0159] While the UE 102 communicates in DC with the MN 106 and SN 104, the MN 106 can perform 580 a LTM DU configuration and/or activation procedure with the UE 102, similar to the procedures 380 and/or 480. In some implementations, while communicating in DC with the MN 106 and SN 104, the UE 102 can transmit the at least one measurement report to the CU 172 via the DU 174 and cell 124A in the events 504 and 506, similar to the events 304 and 306, respectively. In other implementations, while communicating in DC with the MN 106 and SN 104, the UE 102 can transmit 505 at least one measurement report to the MN 106 via the cell 126. The MN 106 in turn transmits 507 the at least one measurement report to the CU 172. In some implementations, the MN 106 generates at least one SN message including the at least one measurement report and transmits the at least one SN message to the CU 172 in the event 507. In one implementation, the at least one SN message include *RRC Transfer* message(s) and/or *SN Modification Request* message(s).

[0160] After (e.g., in response to) receiving the at least one measurement report or while the SN 104 communicates with the UE 102, the SN 104 determines to prepare the first cell for the UE 102, as described for Fig. 3. The events 590, 592, 594, 524, 526, 528, 529, 530, 531, 532, 534, 536, 596, 598, and 556 are similar to the events 390, 392, 394, 324, 326, 328, 329, 330, 331, 332, 334, 336, 396, 398, and 356, respectively. After receiving the first LTM command 530, transmitting the acknowledgement 531, or determining that the UE 102 successfully connects to the first cell 532 or 536, the UE 102 operating in DC with the MN 106 and SN 104 communicates 536 with the DU 174 on the first cell in accordance with the LTM DU configuration 1 and communicates 536 with the CU 172 via the DU 174, similar to the event 336. At a later time, the DU 174 and/or CU 172 can perform the LTM execution procedure 598 with the UE 102 to command the UE 102 to perform a cell change from the first cell to the second cell, similar to the procedure 398 or 498. As a result of the procedure 598, the UE 102 operating in DC with the MN 106 and SN 104 communicates 556 with the DU 174 on the second cell in accordance with the LTM DU configuration 2 and communicates 556 with the CU 172 via the DU 174, similar to the event 356.

[0161] The events 504, 506, 505, 507, 590, 592, 594, 524, 526, 528, 529, 530, 531, 532, 534, 536, 596, 598, 556 are collectively referred to in Fig. 5A as a LTM DU configuration and/or activation procedure 581.

[0162] Referring next to Fig. 5B, a scenario 500B is generally similar to the scenario 500A, except that the SN 104 transmits 517, 519 the RRC reconfiguration message to the UE

102 via the MN 106 and receives 521, 523 the RRC reconfiguration complete message from the UE 102 via the MN 106. The RRC reconfiguration message 517, 519 is similar to the RRC reconfiguration message 316, 318. The RRC reconfiguration complete message 521, 523 is similar to the RRC reconfiguration message 320, 322. In some implementations, the SN 104 generates a first SN message (e.g., *SN Modification Required* message, *SN Modification Required* message, or *RRC Transfer* message) including the RRC reconfiguration message and transmits the first SN message to the MN 106 in the event 517. The MN 106 generates a MN RRC message including the RRC reconfiguration message and transmits 519 the MN RRC message to the UE 102. In response, the UE 102 generates a MN RRC response message including the RRC reconfiguration complete message and transmits 521 the MN RRC response message to the MN 106. In some implementations, the MN 106 generates a second SN message (e.g., *SN Reconfiguration Complete* message or *RRC Transfer* message) including the RRC reconfiguration complete message and transmits the second SN message to the SN 104 in the event 523. In some implementations, the MN RRC message and MN RRC response message can be a RRC reconfiguration message and a RRC reconfiguration complete message, respectively.

[0163] The events 504, 506, 505, 507, 590, 592, 594, 517, 519, 521, 523, 524, 526, 528, 529, 530, 531, 532, 534, 536, 596, 598, 556 are collectively referred to in Fig. 5B as a LTM DU configuration and/or activation procedure 582.

[0164] Referring next to Fig. 6A, in a scenario 600A, the base station 106 operates as an MN, and the base station 104 operates as an SN, similar to the scenarios 300-500B. The SN 104 includes a CU 172, an S-DU 174A and a T-DU 174B, similar to the base station 104 in the scenario 400. While the UE 102 communicates in DC with the MN 106 and SN 104, the MN 106 can perform 680 a LTM DU configuration and/or activation procedure with the UE 102, similar to the procedures 380 and/or 480. While the UE 102 communicates in DC with the M-DU 174A and S-DU 174B, the CU 172 can perform 681 a LTM DU configuration and/or activation procedure with the UE 102 via the M-DU 174A or S-DU 174B, similar to the procedure 581 or 582.

[0165] Referring next to Fig. 6B, a scenario 600B similar to the scenarios 300-500B and 600A, except that that the SN 104 transmits 617, 619 the RRC reconfiguration message to the UE 102 via the MN 106 and receives 621, 623 the RRC reconfiguration complete message from the UE 102 via the MN 106.

[0166] Referring next to Fig. 7A, in a scenario 700A, the base station 104 operates as an MN and an SN, similar to the scenarios 300-600B. The base station 104 includes a CU 172, a master DU (M-DU) 174A and a secondary DU (S-DU) 174B. The CU 172 operates with the M-DU 174A as a MN, similar to the base station 104 in the Fig. 3 or the MN 106 in Figs. 5A-6B, and the CU 172 operates with the S-DU 174B as a SN, similar to the SN 104 in Figs. 5A-6B.

[0167] In the scenario 700A, the UE 102 initially communicates 702 in DC with the M-DU 174A and S-DU 174B and communicates 702 with the CU 172 via the M-DU 174A and S-DU 174B. In the event 702, the UE 102 communicates with the S-DU 174B on cell 124A using a serving DU configuration and communicates with the CU 172 via the S-DU 174B using a serving CU configuration, similar to the event 302. Events 704 and 706 are similar to the events 304 and 306. In some implementations, the UE 102 can transmit 705 at least one measurement report to the M-DU 174A, similar to the event 304. The M-DU 174A in turn transmits 707 at least one DU-to-CU message including the at least one measurement report to the CU 172, similar to the event 306. While the UE 102 communicates in DC with the M-DU 174A and S-DU 174B, the CU 172 can perform 780 a LTM DU configuration and/or activation procedure with the UE 102 via the M-DU 174A, similar to the procedure 380.

[0168] The events 704, 706, 705, 707, 790, 792, 794, 724, 726, 728, 729, 730, 731, 732, 734, 736, 796, 798, 756 are collectively referred to in Fig. 7A as a LTM configuration and/or activation procedure 781.

[0169] Referring next to Fig. 7B, a scenario 700B similar to the scenarios 300-600B and 700A, except that that the CU 172 transmits 717, 719 the RRC reconfiguration message to the UE 102 via the M-DU 174A and receives 721, 723 the RRC reconfiguration complete message from the UE 102 via the M-DU 174A.

[0170] The events 704, 706, 705, 707, 790, 792, 794, 717, 719, 721, 723, 724, 726, 728, 729, 730, 731, 732, 734, 736, 796, 798, 756 are collectively referred to in Fig. 7B as a LTM DU configuration and/or activation procedure 782.

[0171] Referring next to Fig. 8A, in a scenario 800A, the base station 104 operates as an MN and an SN, similar to the scenarios 300-700B. The base station 104 includes a CU 172, a master DU (M-DU) 174A, a secondary DU (S-DU) 174B and a target secondary DU (T-DU) 174C. The CU 172 operates with the M-DU 174A as a MN and operates with the S-DU 174B as a SN. While the UE 102 communicates in DC with the M-DU 174A and S-DU

174B, the CU 172 can perform 880 a LTM DU configuration and/or activation procedure with the UE 102 via the M-DU 174A, similar to the procedure 380. While the UE 102 communicates in DC with the M-DU 174A and S-DU 174B, the CU 172 can perform 881 a LTM DU configuration and/or activation procedure with the UE 102 via the S-DU 174A, similar to the procedure 581 or 582.

[0172] Referring next to Fig. 8B, a scenario 800B similar to the scenarios 300-700B and 800A, except that that the CU 172 transmits 817, 819 the RRC reconfiguration message to the UE 102 via the M-DU 174A and receives 821, 823 the RRC reconfiguration complete message from the UE 102 via the M-DU 174A.

[0173] Next, several example methods, that can be implemented in a RAN node such as a DU or a CU to support configuring a configuration for LTM, are discussed next with reference to Figs. 9A-11C. Examples and implementations described for Figs. 3-8B can apply to Figs. 9A-11C.

[0174] Fig. 9A illustrates an example method 900A, which can be implemented by a DU (e.g., the DU 174 of the base station 104 or 106), for managing LTM configurations for a UE (e.g., the UE 102). For example, the DU is the DU 174 in Figs. 3, 5A or 5B, or the S-DU 174B in Figs. 7A or 7B.

[0175] The method 900A begins at block 902, where the DU receives, from a CU, a first CU-to-DU message including a SpCell ID 1 and at least one first SCell ID to request preparing a SpCell 1 and at least one first SCell for LTM for a UE, respectively (e.g., events 308, 390, 380, 580, 590, 581, 582, 680, 681, 682, 780, 790, 781, 782, 880, 881, 882). At block 904A, the DU generates a LTM DU configuration 1 to configure the SpCell 1 and the at least one first SCell for LTM (e.g., events 308, 310, 390, 380, 580, 590, 581, 582, 680, 780, 790, 781, 782, 880, 881, 882). At block 906A, the DU transmits a first DU-to-CU message including the LTM DU configuration 1 to the CU (e.g., events 310, 390, 380, 580, 590, 581, 582, 680, 780, 790, 781, 782, 880, 881, 882). At block 908, the DU transmits a first message including the LTM DU configuration 1 to the UE (e.g., events 316, 318, 394, 380, 480, 580, 594, 581, 517, 519, 582, 680, 681, 682, 780, 794, 781, 717, 719, 782, 880, 881, 882). At block 910, the DU receives at least one first measurement result for the SpCell 1 (identified by the SpCell ID 1) from the UE via a serving cell (e.g., events 324, 344, 398, 380, 580, 524, 598, 581, 582, 680, 681, 682, 780, 724, 798, 781, 782, 880, 881, 882). At block 912, the DU transmits a LTM command to the UE to order the UE to perform a serving

cell change to the SpCell 1 (e.g., events 330, 380, 580, 530, 581, 581, 680, 681, 682, 780, 730, 781, 782, 880, 881, 882). At block 914, after transmitting the LTM command, the DU detects that the UE accesses the SpCell 1 (e.g., 332, 380, 580, 532, 581, 582, 680, 681, 682, 780, 781, 782, 880, 881, 882). At block 916, the DU communicates with the UE via the SpCell 1 using the LTM configuration 1 (e.g., 336, 380, 580, 536, 581, 582, 680, 681, 682, 780, 781, 782, 880, 881, 882). At block 918A, after transmitting the LTM command, the DU detects that the UE accesses the least one first SCell. At block 920A, the DU communicates with the UE via the at least one first SCell using the LTM configuration 1 (e.g., 336, 380, 436, 480, 580, 536, 581, 582, 680, 636, 681, 682, 780, 736, 781, 782, 880, 836, 881, 882).

[0176] In some implementations, the DU communicates with the UE via a serving SpCell before block 902. In some implementations, the DU communicates with the UE via at least one serving SCell in addition to the serving SpCell before block 902. Thus, the LTM command orders the UE to perform the serving cell change to the SpCell 1 from the serving SpCell. The UE performs the serving cell change to the SpCell 1 from the serving SpCell in response to the LTM command. In some implementations, the DU transmits the LTM command to the UE based on the at least one first measurement result. The DU receives at least one first measurement result for the SpCell 1 from the UE via a serving cell (e.g., the serving SpCell).

[0177] In some implementations, the SpCell ID 1 identifies the SpCell 1. In some implementations, each of the at least one first SCell ID identifies a particular SCell of the at least one first SCell. In some implementations, the DU includes, in the LTM DU configuration 1, a SpCell configuration 1 to configure the SpCell 1. In some implementations, the DU includes a PCI of the SpCell 1 in the SpCell configuration 1. In some implementations, the DU might include, in the LTM DU configuration 1, at least one first SCell configuration to configure the at least one first SCell. Each of the at least one first SCell configuration configures each of the at least one first SCell, respectively. The DU includes a PCI of each of the at least one first SCell configuration and the each PCI configures the each of the at least one first SCell, respectively. In other implementations, if the DU is communicating with the UE via the at least one first SCell using at least one existing SCell configuration, the DU might not include the at least one first SCell configuration in the LTM DU configuration 1 to configure the UE to continue using the existing SCell configuration(s). In yet other implementations, if the DU is communicating with the UE via the at least one first SCell using at least one existing SCell configuration, the

DU might include, in the LTM DU configuration 1, some of the at least one first SCell configuration for some of the at least one first SCell and not include the rest of the at least one first SCell. Thus, the DU communicates with the UE via the some of the at least one first SCell using the some of the at least one first SCell configuration and communicates with the UE via the rest of the SCell using the existing SCell configuration(s) that the DU is using to communicate with the UE via the rest of the at least one first SCell.

[0178] In some implementations, the CU includes, in the first message, a LTM ID 1 identifying the LTM DU configuration 1. In some implementations, the CU can generate an element 1 (e.g., LTM configuration 1) including the LTM ID 1 and the LTM DU configuration 1 and include the element 1 in the first message. In some implementations, the CU includes a LTM CU configuration 1 in the element 1.

[0179] In some implementations, the CU and DU can configure a SpCell 2 and/or at least one second SCell for LTM for the UE, similar to blocks 902, 904A, 906A, 908. In other implementations, the CU can include SpCell ID 2 in the first CU-to-DU message to request preparing a SpCell 2 identified by the SpCell ID 2. In one implementation, the DU might generate a LTM DU configuration 2 to configure the SpCell 2 and include the LTM DU configuration 2 in the first DU-to-CU message. In one implementation, the CU might not include a SCell ID in the first CU-to-DU message to request prepare a SCell for LTM. If the CU includes the at least one second SCell ID in the first CU-to-DU message to request prepare at least one second SCell for LTM, the CU includes at least one second SCell configuration in the LTM configuration 2 to configure the at least one second SCell. Each of the at least one second SCell ID identifies a particular SCell of the at least one second SCell. The CU then includes an LTM ID 2 and the LTM DU configuration 2 in the first message. The LTM ID 2 identifies the LTM DU configuration 2. In some implementations, the CU can generate an element 2 (e.g., LTM configuration 2) including the LTM ID 2 and the LTM DU configuration 2 and include the element 2 in the first message. In some implementations, the CU includes a LTM CU configuration 2 in the element 2.

[0180] In some implementations, the DU includes a reference LTM DU configuration in the first DU-to-CU message. The CU includes the reference LTM DU configuration in the first message. In some implementations, the CU includes a reference LTM CU configuration in the first message. In one implementation, the CU includes the reference LTM DU

configuration and/or the reference LTM CU configuration in a reference LTM configuration and includes the reference LTM configuration in the first message.

[0181] Fig. 9B is a flow diagram of an example method 900B similar to the method 900A, except that the method 900B includes blocks 917B and 918B instead of blocks 916 and 918A. At block 917B, the DU transmits a SCell activation command to the UE to activate the at least one first SCell. At block 918B, after transmitting the SCell activation command, the DU detects that the UE accesses the least one first SCell.

[0182] In some implementations, the DU receives at least one second measurement result for the at least one first SCell from the UE while communicating with the UE via the SpCell 1. The DU transmits the SCell activation command to the UE via the SpCell 1 to activate the at least one first SCell. The UE activates communication on the at least one first SCell after (e.g., in response to) receiving the SCell activation command. Thus, the DU communicates with the UE via the at least one first SCell after transmitting the SCell activation command.

[0183] Fig. 9C is a flow diagram of an example method 900C similar to the methods 900A and 900B, except that the method 900C includes block 922C. At block 922C, the DU determines whether the at least one first SCell is configured to be activated in the LTM configuration 1. If the DU determines that the at least one first SCell is configured to be activated in the LTM configuration 1 at block 922C, the flow proceeds to blocks 918A and 920A. For each of the at least one first SCell, the DU can include an indication in the LTM configuration 1 to indicate the SCell is activated. In response to the indication, the UE accesses the corresponding SCell immediately in accordance with the LTM configuration 1, in response to the LTM command. Otherwise, if the DU determines that the at least one first SCell is configured to be not activated in the LTM configuration 1 at block 922C, the flow proceeds to blocks 917A, 918A and 920A. For example, the LTM configuration 1 does not include an indication indicating the at least one first SCell is activated. In this case, the UE does not access the at least one first SCell in response to the LTM command.

[0184] Fig. 9D is a flow diagram of an example method 900D similar to the method 900A, except that the method 900D includes blocks 904D, 906D, 918D, and 920D instead of blocks 904A, 906A, 918A, and 920A. At block 904D, the DU generates a LTM DU configuration 1 to configure the SpCell 1 and at least one second SCell of at the least one first SCell for LTM, where the number of the at least one second SCell is smaller than the number of at least one first SCell (e.g., events 308, 310, 390, 380, 580, 590, 581, 582, 680, 780, 790, 781,

782, 880, 881, 882). At block 906D, the DU transmits a first DU-to-CU message including the LTM DU configuration 1 and indicating failure of configuring the rest of the at least one first SCell to the CU (e.g., events 310, 390, 380, 580, 590, 581, 582, 680, 780, 790, 781, 782, 880, 881, 882). At block 918D, after transmitting the LTM command, the DU detects that the UE accesses the least one second SCell. At block 920D, the DU communicates with the UE via the at least one second SCell using the LTM configuration 1 (e.g., 336, 380, 580, 536, 581, 582, 680, 681, 682, 780, 781, 782, 880, 881, 882).

[0185] In some scenarios or implementations, the DU fails to configure the rest of the at least one first SCell, because the DU does not have enough resources to configure the at least one first SCell or the rest of the at least one first SCell is not available.

[0186] Fig. 9E is a flow diagram of an example method 900E similar to the methods 900A and 900D, except that method 900E includes blocks 917E and 918E instead of blocks 916, 918A and 918D. At block 917E, the DU transmits a SCell activation command to the UE to activate the at least one second SCell. At block 918E, after transmitting the SCell activation command, the DU detects that the UE accesses the least one second SCell.

[0187] In some implementations, the DU receives at least one second measurement result for the at least one second SCell from the UE while communicating with the UE via the SpCell 1. The DU transmits the SCell activation command to the UE via the SpCell 1 to activate the at least one second SCell. The UE activates communication on the at least one second SCell after (e.g., in response to) receiving the SCell activation command. Thus, the DU communicates with the UE via the at least one second SCell after transmitting the SCell activation command.

[0188] Fig. 9F is a flow diagram of an example method 900F similar to the methods 900A-E, except that the method 900F includes block 922F. At block 922F, the DU determines whether the at least one second SCell is configured to be activated in the LTM configuration 1. If the DU determines that the at least one second SCell is configured to be activated in the LTM configuration 1 at block 922F, the flow proceeds to blocks 918D and 920D. Otherwise, if the DU determines that the at least one second SCell is not configured to be activated in the LTM configuration 1 at block 922F, the flow proceeds to blocks 917E, 918E and 920D.

[0189] Fig. 9G is a flow diagram of an example method 900G similar to the method 900A, except that method 900G includes blocks 904G and 906G instead of blocks 904A, 906A, 918A, and 920A. At block 904G, the DU generates a LTM DU configuration 1 to configure

the SpCell 1 only. In other words, the DU determines not to configure the at least one first SCell for the UE. In some scenarios or implementations, the DU determines not to configure the at least one first SCell for the UE, because the DU does not have enough resources to configure the at least one first SCell or the at least one first SCell is not available. At block 906G, the DU transmits a first DU-to-CU message including the LTM DU configuration 1 and indicating failure of configuring the at least one first SCell to the CU (e.g., events 310, 390, 380, 580, 590, 581, 582, 680, 780, 790, 781, 782, 880, 881, 882).

[0190] In some implementations, the DU communicates with the UE via a serving SpCell before block 902. In some implementations, the DU communicates with the UE via at least one serving SCell in addition to the serving SpCell before block 902. In some scenarios or implementations, the DU does not configure the at least one first SCell for LTM because the DU does not support carrier aggregation for LTM (i.e., configuring a SCell for LTM). Thus, the DU and the UE communicate with each other via the SpCell 1 at block 916. The DU releases the at least one serving SCell that the DU used to communicate with the UE before block 902. If the DU supports carrier aggregation for LTM, the DU might configure some or all of the at least one first SCell for the UE as described in Figs. 9A-9F.

[0191] Fig. 10A illustrates an example method 1000A, which can be implemented by a DU (e.g., the DU 174 of the base station 104 or 106), for managing LTM configurations for a UE (e.g., the UE 102). For example, the DU is the T-DU 174B in Figs. 4, 6A or 6B, or the T-DU 174C in Figs. 8A or 8B.

[0192] The method 1000A begins at block 1002, where the DU receives, from a CU, a first CU-to-DU message including a SpCell ID 1 and at least one first SCell ID to request preparing a SpCell 1 and at least one first SCell for LTM for a UE, respectively (e.g., events 490, 480, 580, 680, 690, 780, 880, 890). At block 1004A, the DU generates a LTM DU configuration 1 to configure the SpCell ID 1 and the at least one first SCell for LTM (e.g., events 490, 480, 580, 680, 690, 780, 880, 890). At block 1006A, the DU transmits a first DU-to-CU message including the LTM DU configuration 1 to the CU (e.g., events 490, 480, 580, 680, 690, 780, 880, 890). At block 1014, after transmitting the LTM DU configuration 1, the DU detects that the UE accesses the SpCell 1 (e.g., 432, 480, 580, 680, 632, 780, 880, 832). At block 1016, the DU communicates with the UE via the SpCell 1 using the LTM configuration 1 (e.g., events 436, 480, 580, 680, 636, 780, 880, 836). At block 1018A, the DU detects that the UE accesses the at least one first SCell. At block 1020A, the DU

communicates with the UE via the at least one first SCell using the LTM configuration 1 (e.g., events 436, 480, 580, 680, 636, 780, 880, 836).

[0193] Examples and implementations described for Fig. 9A can apply to Fig. 10A.

[0194] Fig. 10B is a flow diagram of an example method 1000B similar to the method 1000A, except that the method 1000B includes blocks 1017B and 1018B instead of blocks 1016 and 1018A. At block 1017B, the DU transmits a SCell activation command to the UE to activate the at least one first SCell. At block 1018B, the DU detects that the UE accesses the least one first SCell after transmitting the SCell activation command.

[0195] Examples and implementations described for Fig. 9B can apply to Fig. 10B.

[0196] Fig. 10C is a flow diagram of an example method 1000C similar to the methods 1000A and 1000B, except that the method 1000C includes block 1022C. At block 1022C, the DU determines whether the at least one first SCell is configured to be activated in the LTM configuration 1. If the DU determines that the at least one first SCell is configured to be activated in the LTM configuration 1 at block 1022C, the flow proceeds to blocks 1018A and 1020A. Otherwise, if the DU determines that the at least one first SCell is configured to be not activated in the LTM configuration 1 at block 1022C, the flow proceeds to blocks 1017A, 1018A and 1020A.

[0197] Examples and implementations described for Fig. 9C can apply to Fig. 10C.

[0198] Fig. 10D is a flow diagram of an example method 1000D similar to the method 1000A, except that the method 1000D includes blocks 1004D, 1006D, 1018D, and 1020D instead of blocks 1004A, 1006A, 1018A, and 1020A. At block 1004D, the DU generates a LTM DU configuration 1 to configure the SpCell 1 and at least one second SCell of at the least one first SCell for LTM, where the number of the at least one second SCell is smaller than the number of at least one first SCell (e.g., events 490, 480, 580, 680, 690, 780, 880, 890). At block 1006D, the DU transmits a first DU-to-CU message including the LTM DU configuration 1 and indicating failure of configuring the rest of the at least one first SCell to the CU (e.g., events 490, 480, 580, 680, 690, 780, 880, 890). At block 1018D, after transmitting the LTM command, the DU detects that the UE accesses the least one second SCell (e.g., 432, 480, 580, 680, 632, 780, 880, 832). At block 1020D, the DU communicates with the UE via the at least one second SCell using the LTM configuration 1 (e.g., events 436, 480, 580, 680, 636, 780, 880, 836).

[0199] Examples and implementations described for Fig. 9D can apply to Fig. 10D.

[0200] Fig. 10E is a flow diagram of an example method 1000E similar to the methods 1000A and 1000D, except that method 900E includes blocks 1017E and 1018E instead of blocks 1016, 1018A and 1018D. Fig. 10E is similar to Fig. 9E. Examples and implementations described for Fig. 9E can apply to Fig. 10E.

[0201] Fig. 10F is a flow diagram of an example method 1000F similar to the methods 1000A-E, except that the method 1000F includes block 1022F. Fig. 10F is similar to Fig. 9F. Examples and implementations described for Fig. 9F can apply to Fig. 10F.

[0202] Fig. 10G is a flow diagram of an example method 1000G similar to the method 1000A, except that the method 1000G includes blocks 904G and 906G instead of blocks 1004A, 1006A, 1008A, and 1020A. Fig. 10G is similar to Fig. 9G. Examples and implementations described for Fig. 9G can apply to Fig. 10G.

[0203] Next, Figs. 11A-11C illustrates example methods for a CU, which can a CU described in Figs. 9A-9G and 10A-10G. The descriptions for Figs. 9A-9G and 10A-10G can apply to Figs. 11A-11C.

[0204] Fig. 11A illustrates an example method 1100A, which can be implemented by a CU (e.g., the CU 172 of the base station 104 or 106), for managing LTM configurations for a UE (e.g., the UE 102).

[0205] The method 1100A begins at block 1102, where the CU communicates with a UE via a serving DU (e.g., 302, 402, 502, 602, 702, 802, 380, 480, 580, 680, 780, 880). At block 1104, the CU transmits, to a first DU, a first CU-to-DU message including a SpCell ID 1 and at least one first SCell ID to request preparing a SpCell 1 and at least one first SCell for LTM for a UE, respectively (e.g., events 308, 390, 380, 490, 480, 580, 590, 581, 582, 680, 690, 681, 682, 780, 790, 781, 782, 880, 890, 881, 882). At block 1106A, the CU receives a first DU-to-CU message including LTM DU configuration 1 from the first DU, where the LTM DU configuration 1 configures the SpCell 1 and the at least one first SCell for LTM (e.g., events 310, 390, 380, 490, 480, 580, 590, 581, 582, 680, 690, 681, 682, 780, 790, 781, 782, 880, 890, 881, 882). At block 1108, the CU transmits a first message including the LTM DU configuration 1 to the UE via a serving DU (e.g., events 316, 318, 394, 380, 480, 494, 580, 594, 581, 517, 519, 582, 680, 694, 681, 617, 619, 682, 780, 794, 781, 717, 719, 782, 880, 894, 881, 817, 819, 882). At block 1110, the CU receives a second DU-to-CU message indicating that the UE accesses the SpCell 1 from the first DU (e.g., events 334, 380, 434,

480, 580, 534, 581, 582, 680, 681, 682, 634, 780, 781, 782, 734, 880, 881, 882, 834). At block 1112, the CU communicates with the UE via the first DU using at least one CU configuration (e.g., events 336, 380, 436, 480, 580, 536, 581, 582, 680, 681, 682, 636, 780, 781, 782, 736, 880, 881, 882, 836). At block 1114A, the CU receives a second DU-to-CU message indicating that the UE accesses the least one first SCell after transmitting the LTM command.

[0206] In some implementations, the at least one CU configuration includes a serving CU configuration, a reference LTM CU configuration and/or a non-reference LTM CU configuration (e.g., the LTM CU configuration 1 described in Figs. 3-8B). The CU uses the serving CU configuration to communicate with the UE at block 1102.

[0207] In some implementations, the first DU and the serving DU are the same DU. In other implementations, the first DU and the serving DU are different DUs.

[0208] Fig. 11B is a flow diagram of an example method 1100B similar to the method 1100A, except that method 1100B includes blocks 1106B and 1114B instead of blocks 1106A and 1114A. At block 1106B, the CU receives a first DU-to-CU message including LTM DU configuration 1 from the first DU, where the LTM DU configuration 1 configures the SpCell 1 and the at least one first SCell for LTM and the first DU-to-CU message indicates failure of configuring the rest of the at least one first SCell (e.g., events 310, 390, 380, 490, 480, 580, 590, 581, 582, 680, 690, 681, 682, 780, 790, 781, 782, 880, 890, 881, 882). At block 1114B, the CU receives a second DU-to-CU message indicating that the UE accesses the least one second SCell after transmitting the LTM command.

[0209] Fig. 11C is a flow diagram of an example method 1100C similar to the method 1100A, except that method 1100C includes block 1106C instead of blocks 1106A and 1114A. At block 1106C, the CU receives a first DU-to-CU message including LTM DU configuration 1 from the first DU, where the LTM DU configuration 1 configures the SpCell 1 only and the first DU-to-CU message indicates failure of configuring the at least one first SCell (e.g., events 310, 390, 380, 490, 480, 580, 590, 581, 582, 680, 690, 681, 682, 780, 790, 781, 782, 880, 890, 881, 882).

[0210] The following description may be applied to the description above.

[0211] Generally speaking, description for one of the above figures can apply to another of the above figures. Examples, implementations and methods described above can be combined, if there is no conflict. An event or block described above can be optional or

omitted. For example, an event or block with dashed lines in the figures can be optional. In some implementations, “message” is used and can be replaced by “information element (IE)”, and vice versa. In some implementations, “IE” is used and can be replaced by “field”, and vice versa. In some implementations, “configuration” can be replaced by “configurations” or “configuration parameters”, and vice versa. In some implementations, the “LTM command” can be replaced by “serving cell change command”, “Layer 1/Layer 2 switching command”, “lower layer switching command” or “lower layer serving cell change command”. In some implementations, “some” means “one or more”. In some implementations, “at least one” means “one or more”. In some implementations, the “DU configuration” can be replaced by “cell group configuration”. In some implementations, the “cell index” can be replaced with “serving cell index”, “LTM cell index”, “special cell (SpCell) index”, “PCell index” or “PSCell index”.

[0212] A user device in which the techniques of this disclosure can be implemented (*e.g.*, the UE 102) can be any suitable device capable of wireless communications such as a smartphone, a tablet computer, a laptop computer, a mobile gaming console, a point-of-sale (POS) terminal, a health monitoring device, a drone, a camera, a media-streaming dongle or another personal media device, a wearable device such as a smartwatch, a wireless hotspot, a femtocell, or a broadband router. Further, the user device in some cases may be embedded in an electronic system such as the head unit of a vehicle or an advanced driver assistance system (ADAS). Still further, the user device can operate as an internet-of-things (IoT) device or a mobile-internet device (MID). Depending on the type, the user device can include one or more general-purpose processors, a computer-readable memory, a user interface, one or more network interfaces, one or more sensors, etc.

[0213] Certain embodiments are described in this disclosure as including logic or a number of components or modules. Modules may can be software modules (*e.g.*, code, or machine-readable instructions stored on non-transitory machine-readable medium) or hardware modules. A hardware module is a tangible unit capable of performing certain operations and may be configured or arranged in a certain manner. A hardware module can comprise dedicated circuitry or logic that is permanently configured (*e.g.*, as a special-purpose processor, such as a field programmable gate array (FPGA) or an application-specific integrated circuit (ASIC), a digital signal processor (DSP), etc.) to perform certain operations. A hardware module may also comprise programmable logic or circuitry (*e.g.*, as encompassed within a general-purpose processor or other programmable processor) that is

temporarily configured by software to perform certain operations. The decision to implement a hardware module in dedicated and permanently configured circuitry, or in temporarily configured circuitry (*e.g.*, configured by software) may be driven by cost and time considerations.

[0214] When implemented in software, the techniques can be provided as part of the operating system, a library used by multiple applications, a particular software application, etc. The software can be executed by one or more general-purpose processors or one or more special-purpose processors.

[0215] Upon reading this disclosure, those of skill in the art will appreciate still additional and alternative structural and functional designs for handling mobility between base stations through the principles disclosed herein. Thus, while particular embodiments and applications have been illustrated and described, it is to be understood that the disclosed embodiments are not limited to the precise construction and components disclosed herein. Various modifications, changes and variations, which will be apparent to those of ordinary skill in the art, may be made in the arrangement, operation and details of the method and apparatus disclosed herein without departing from the spirit and scope defined in the appended claims.

What is claimed is:

1. A method in a distributed unit (DU) of a distributed base station, the method comprising:
 - receiving, from a central unit (CU) of the distributed base station, a CU-to-DU message including a request to prepare a low-layer mobility (LTM) DU configuration for a user equipment (UE), the request including a special cell (SpCell) identity (ID) and a secondary cell (SCell) ID;
 - generating the LTM DU configuration for an SpCell corresponding to the SpCell ID and an SCell corresponding to the SCell ID; and
 - transmitting the LTM DU configuration to the CU.
2. The method of claim 1, wherein the generating the LTM DU configuration for the SCell is in response to:
 - determining that the DU supports carrier aggregation (CA) for LTM.
3. The method of claim 1 or 2, wherein:
 - the CU-to-DU message includes N SCell IDs, and
 - the generating of the LTM DU configuration includes configuring M SCells, wherein $M < N$.
4. The method of any of the preceding claims, further comprising:
 - transmitting the LTM DU configuration to the UE.
5. The method of any of the preceding claims, further comprising:
 - receiving, via a serving cell of the UE, a measurement result for the SpCell; and
 - transmitting, to the UE, a command to initiate a serving cell change to the SpCell.
6. The method of any of the preceding claims, further comprising:
 - detecting that the UE has accessed the SpCell;
 - communicating with the UE in the SpCell using the LTM DU configuration.
7. The method of claim 6, further comprising, subsequently to the communicating with the UE in the SpCell:

detecting that the UE has accessed the SCell; and
communicating with the UE in the SCell using the LTM DU configuration.

8. The method of claim 6, further comprising, subsequently to the communicating with the UE in the SpCell:

transmitting, to the UE, a cell activation command to activate the SCell; and
communicating with the UE in the SCell using the LTM DU configuration.

9. The method of claim 8, wherein the transmitting of the cell activation command is in response to determining that the LTM DU configuration does configure activation of the SCell.

10. The method of claim of any of the preceding claims, further comprising:
receiving, from the CU, a reference LTM DU configuration;
wherein the generating of the LTM DU configuration includes using the reference LTM DU configuration.

11. The method of claim 10, wherein the reference LTM DU configuration is a delta configuration.

12. The method of any of the preceding claims, wherein the DU operates as a secondary DU (S-DU) to provide, with a master node (MN), dual connectivity to the UE.

13. The method of any of the preceding claims, wherein the SCell ID is a physical cell ID (PCI).

14. The method of any of the preceding claims, wherein the CU-to-DU message includes a cell index different from the SPCell ID and the SCell ID.

15. A radio access network (RAN) node comprising a transceiver and processing hardware, the RAN configured to implement a method of any of the preceding claims.

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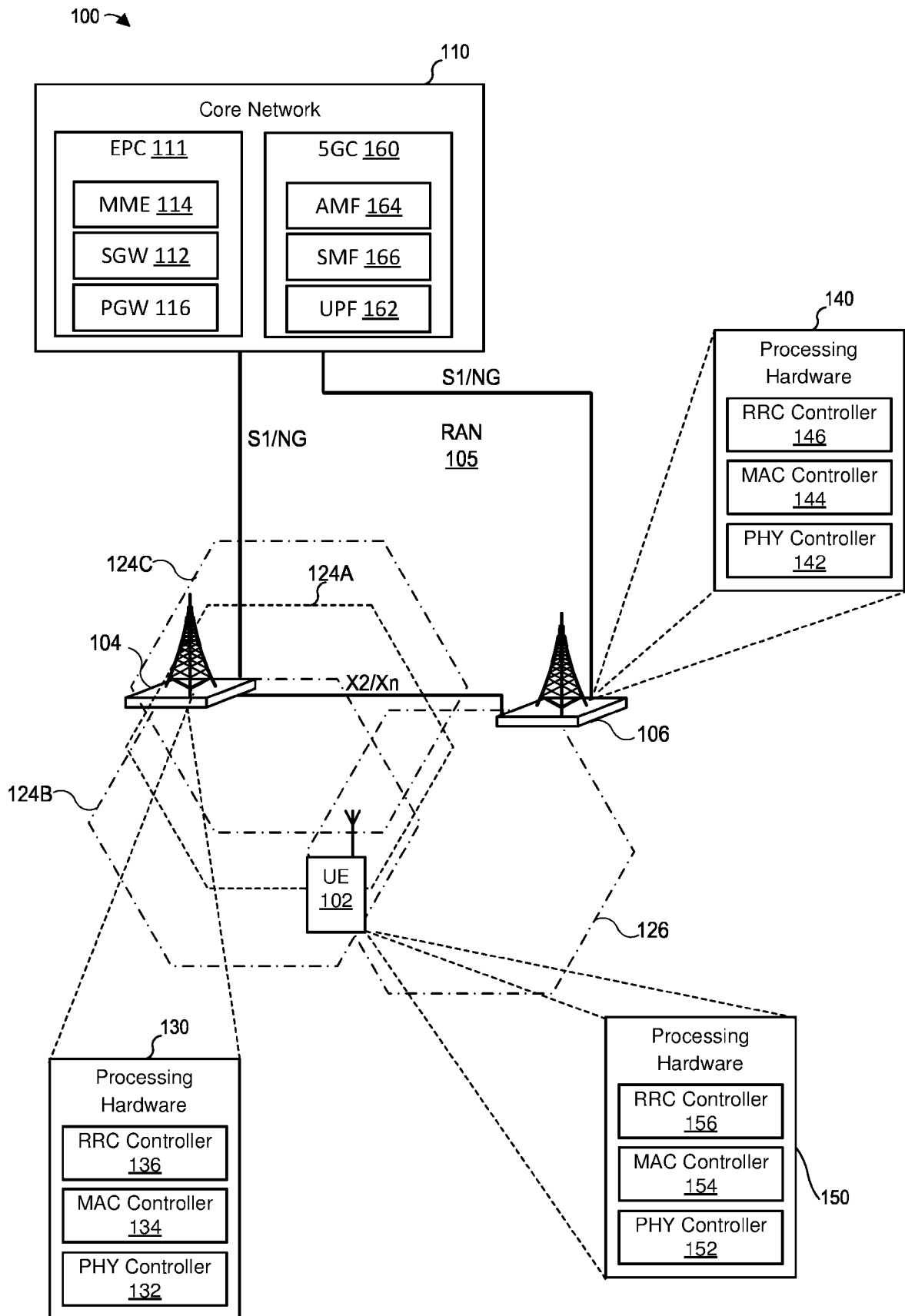


Figure 1A

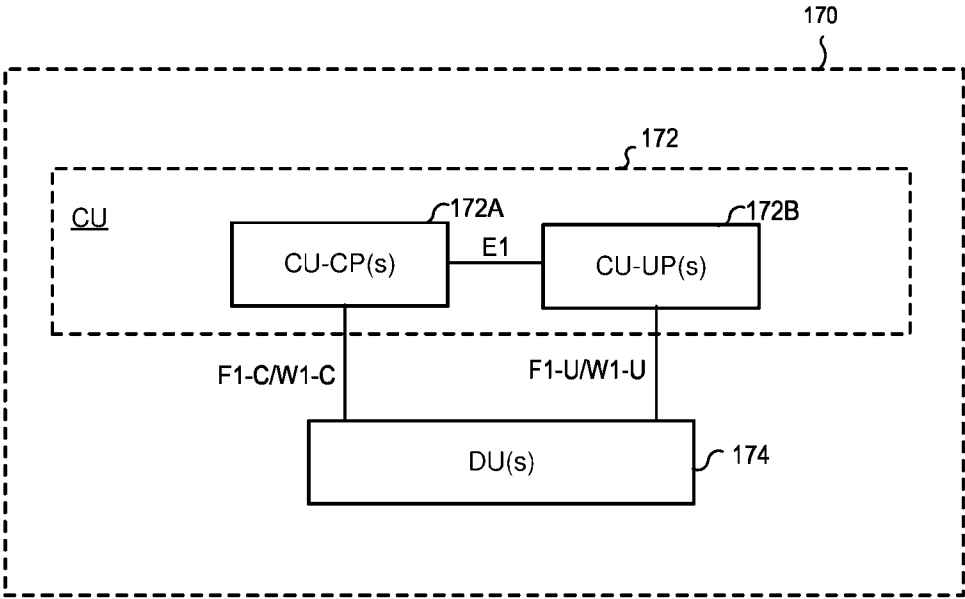


Figure 1B

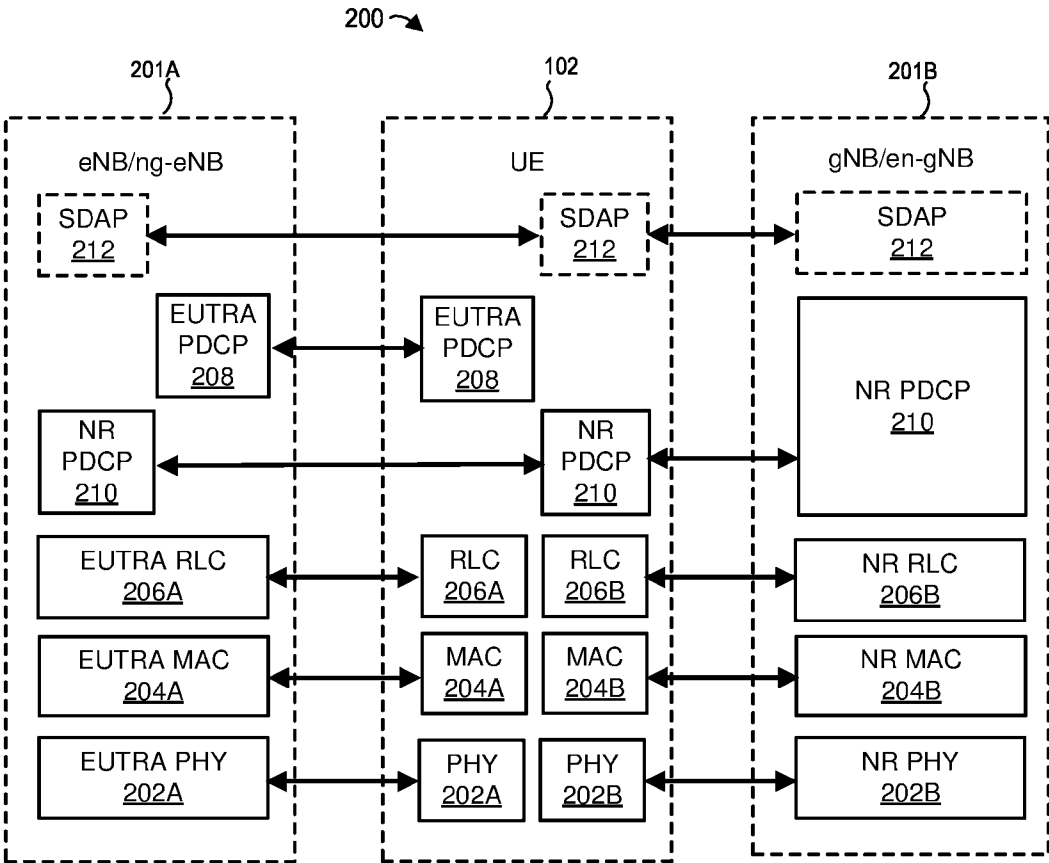


Figure 2A

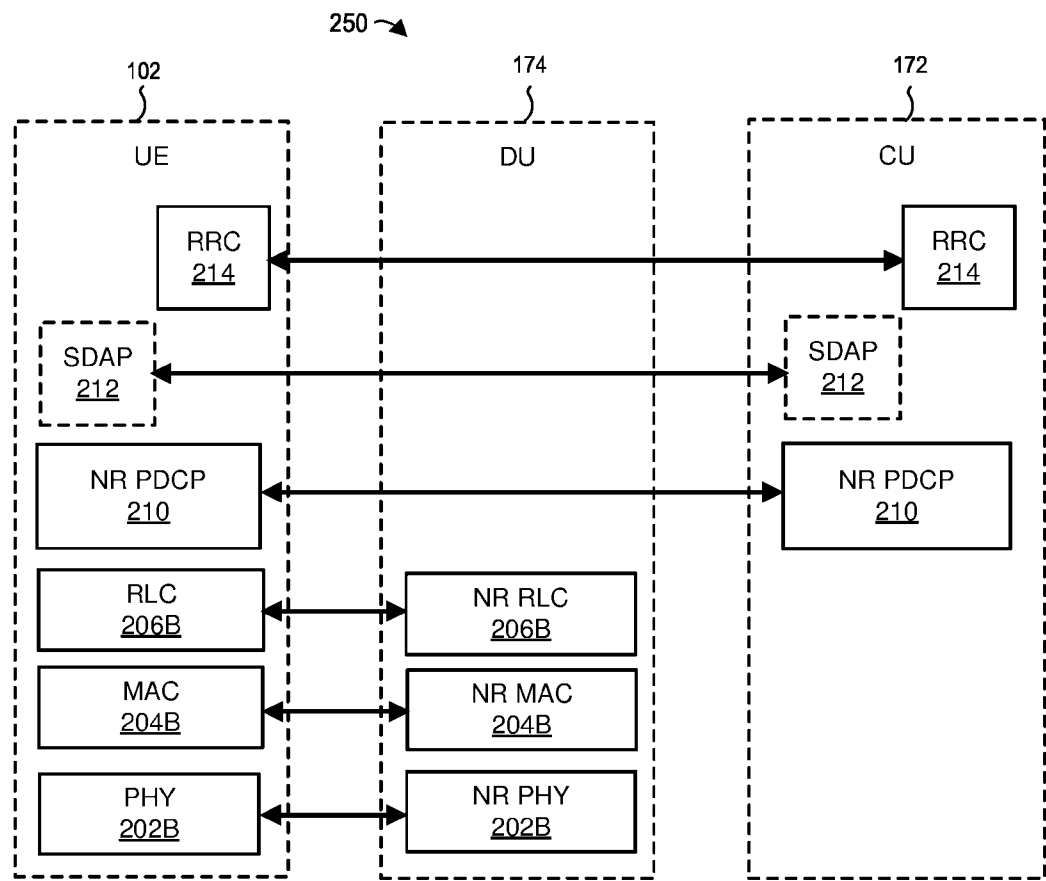


Figure 2B

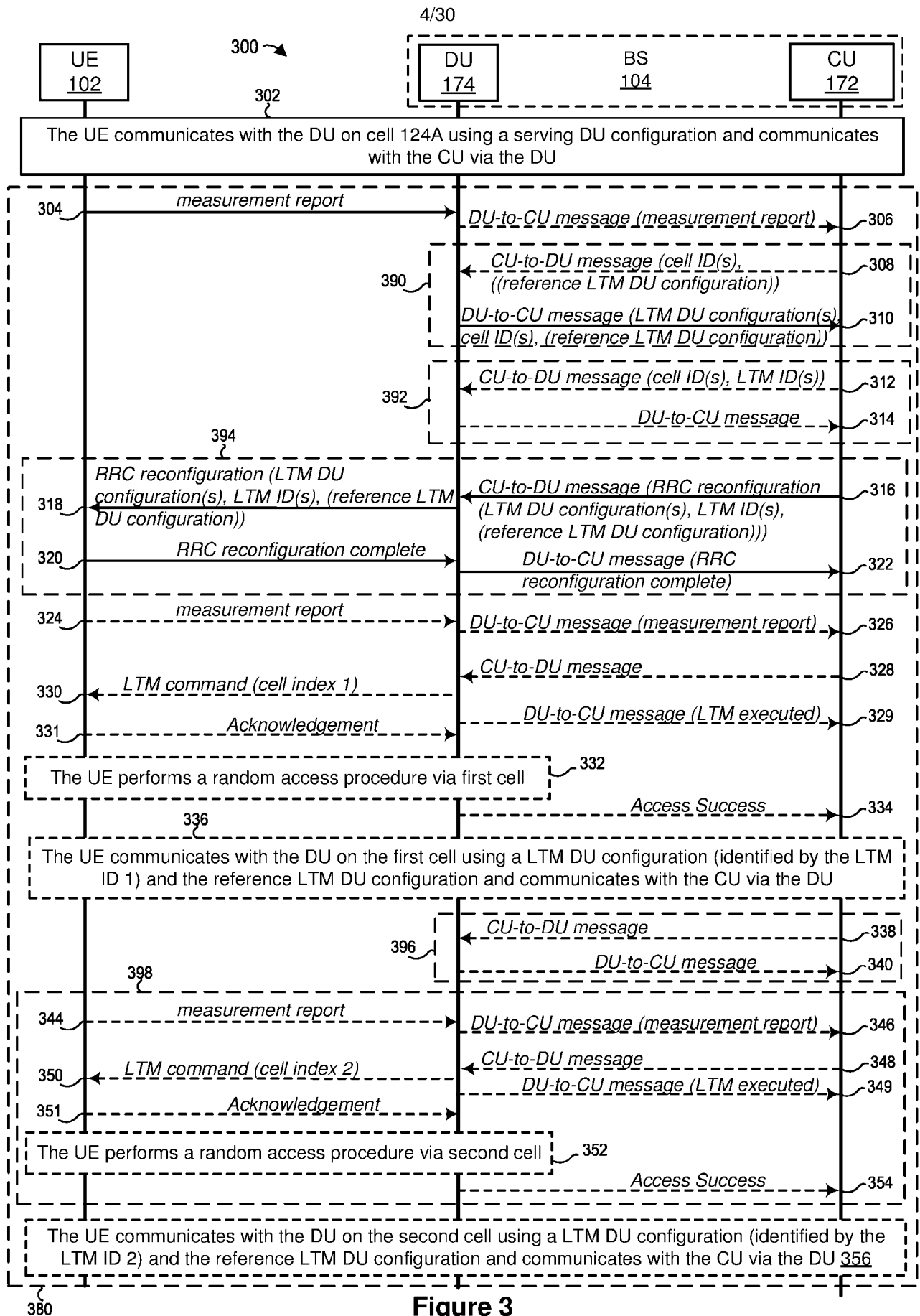


Figure 3

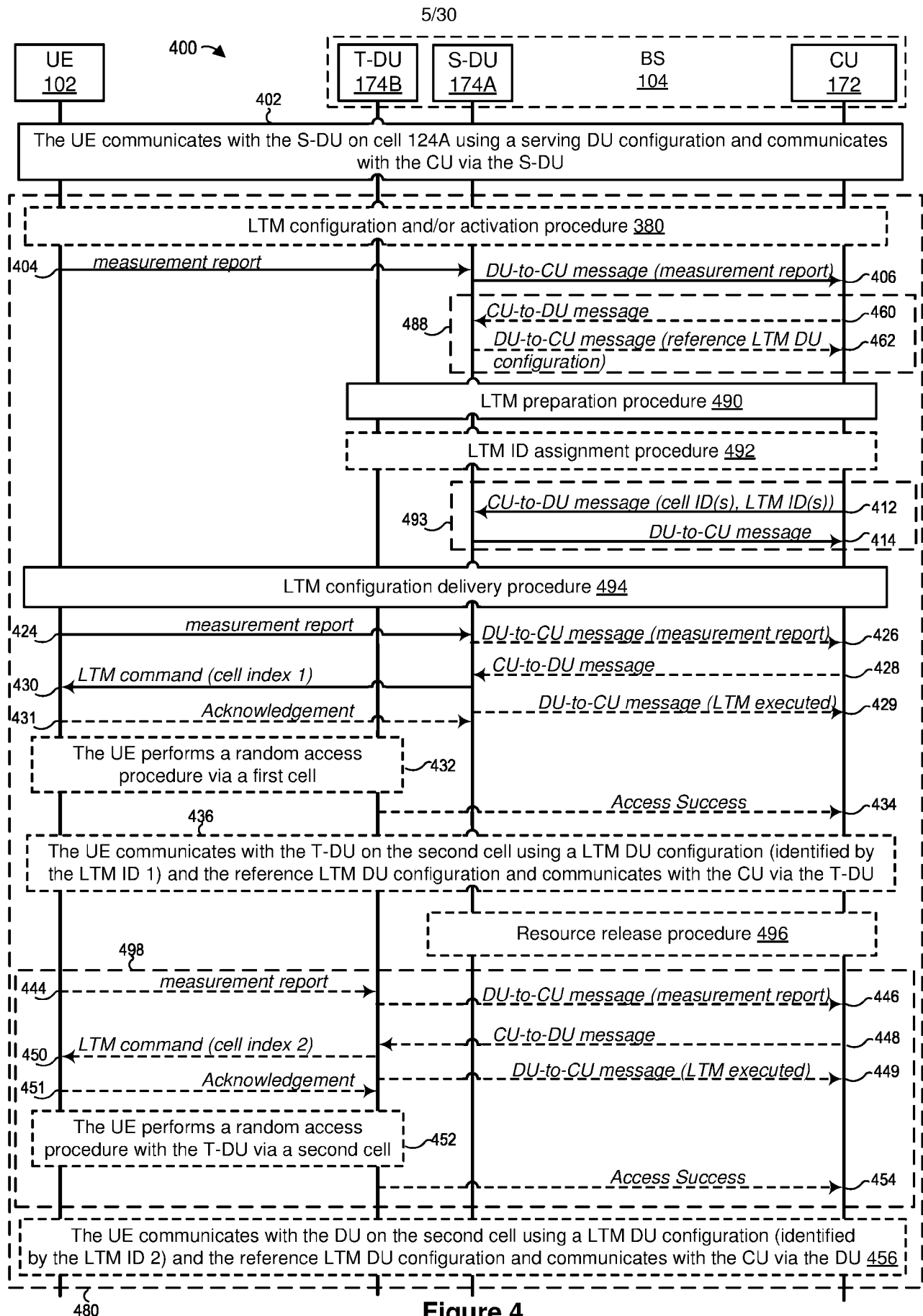


Figure 4

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500A

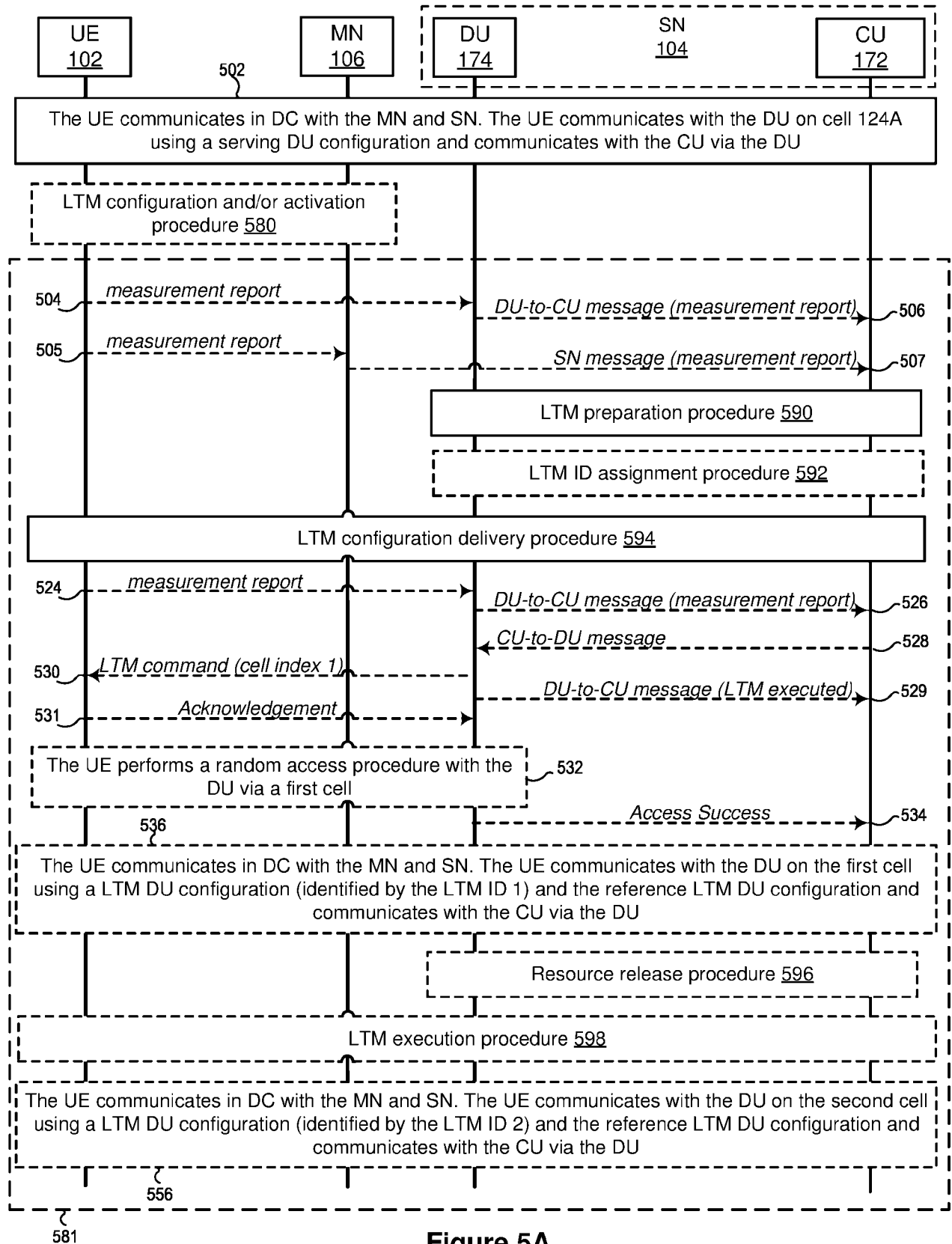


Figure 5A

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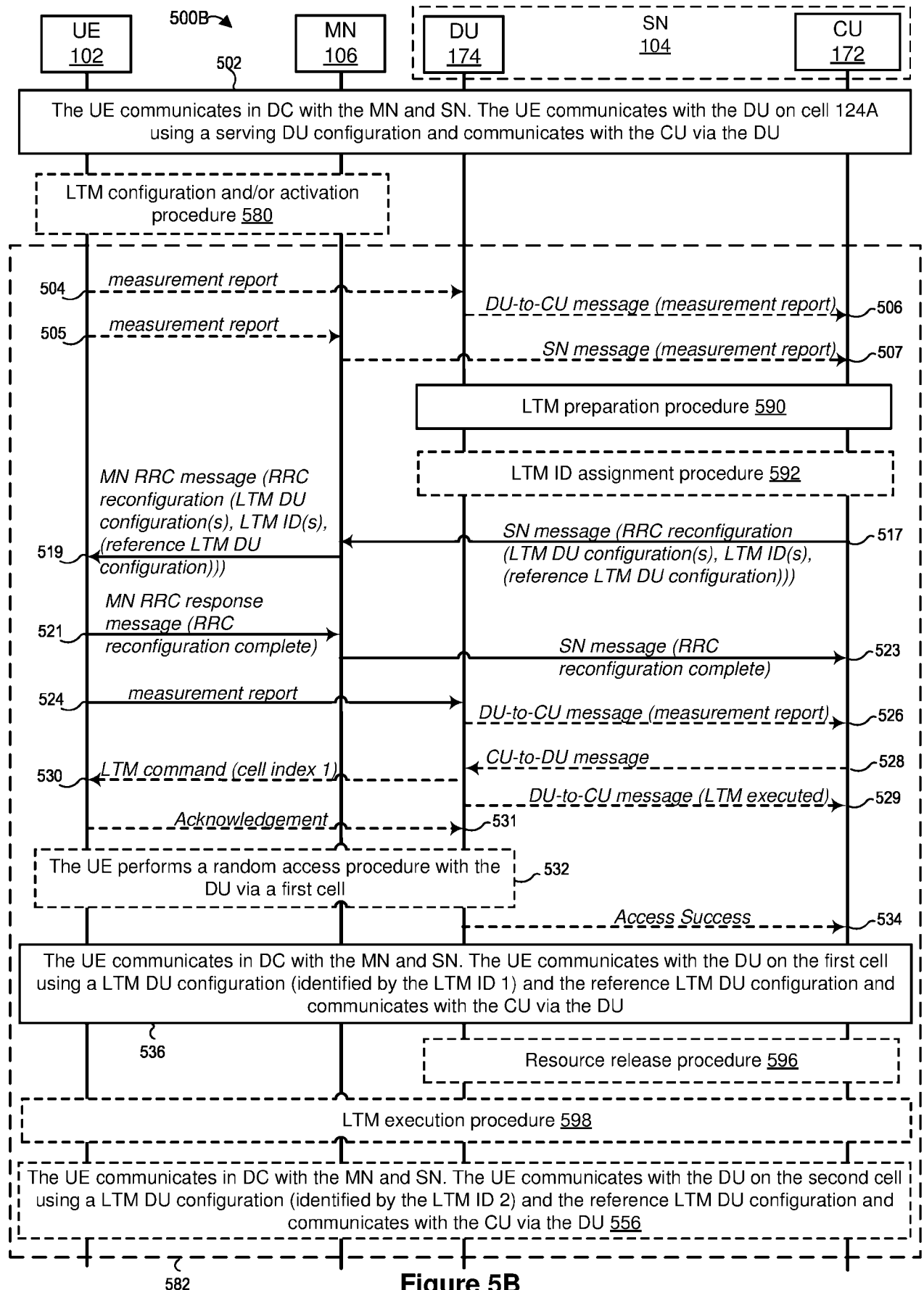


Figure 5B

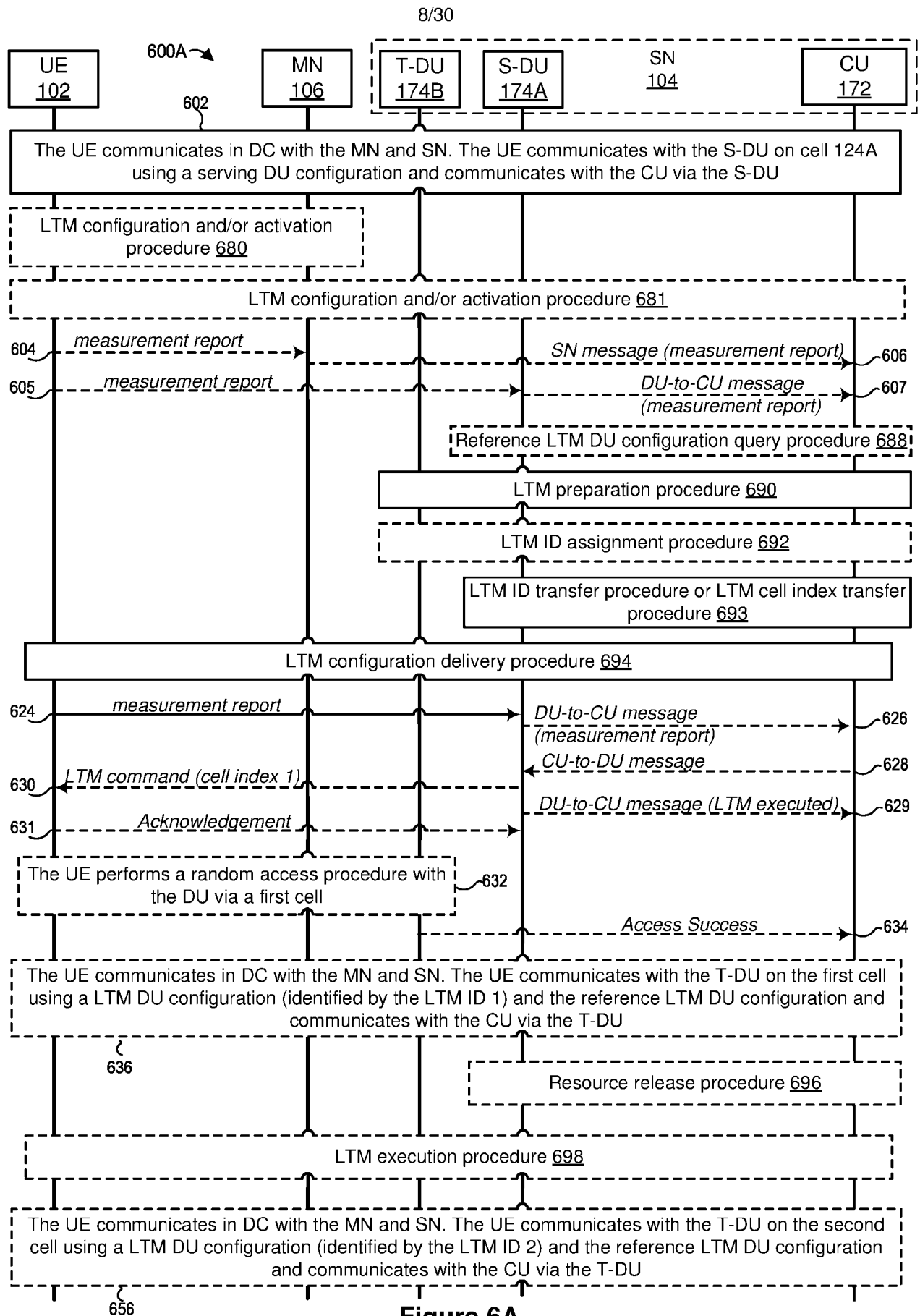
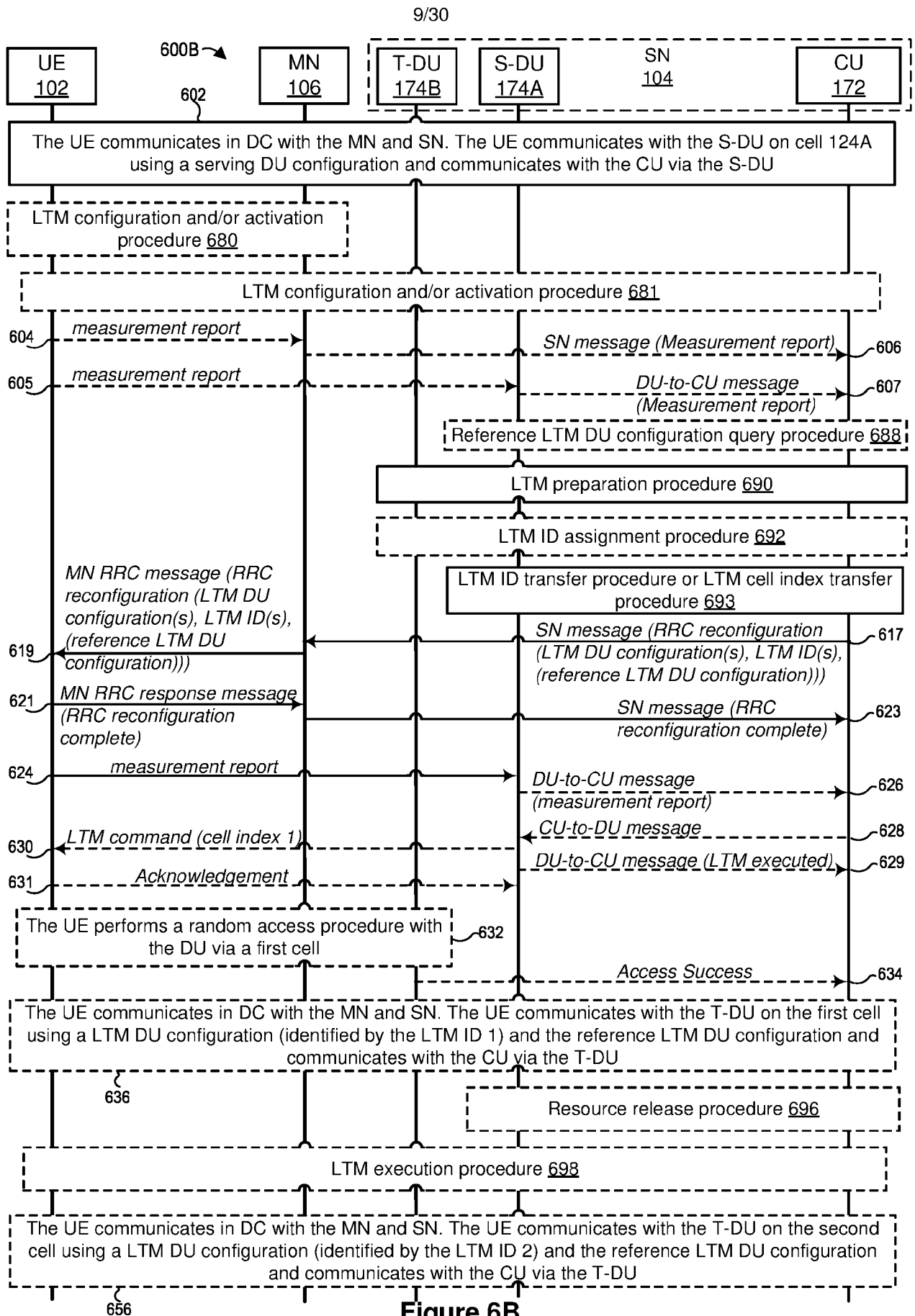


Figure 6A



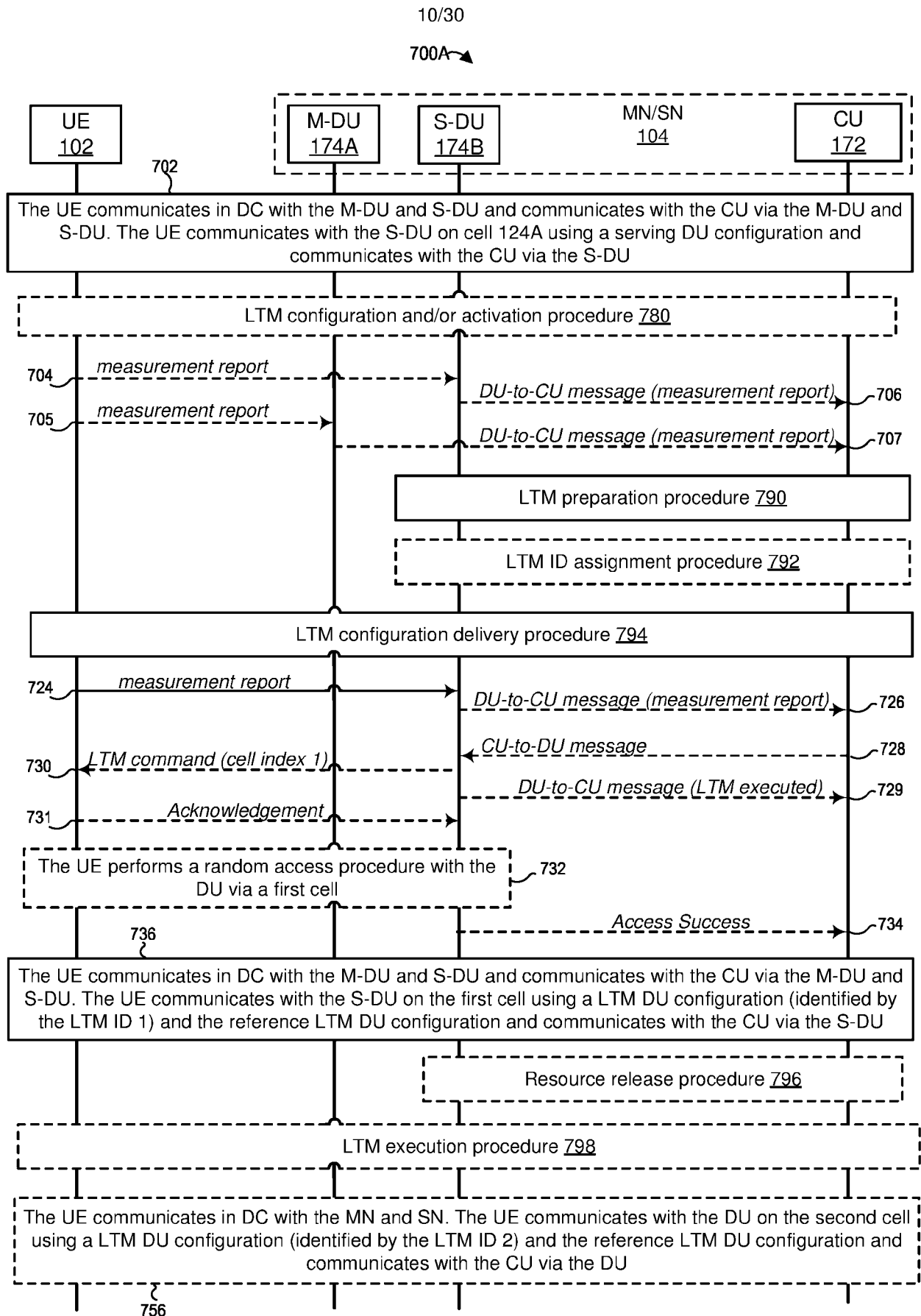


Figure 7A

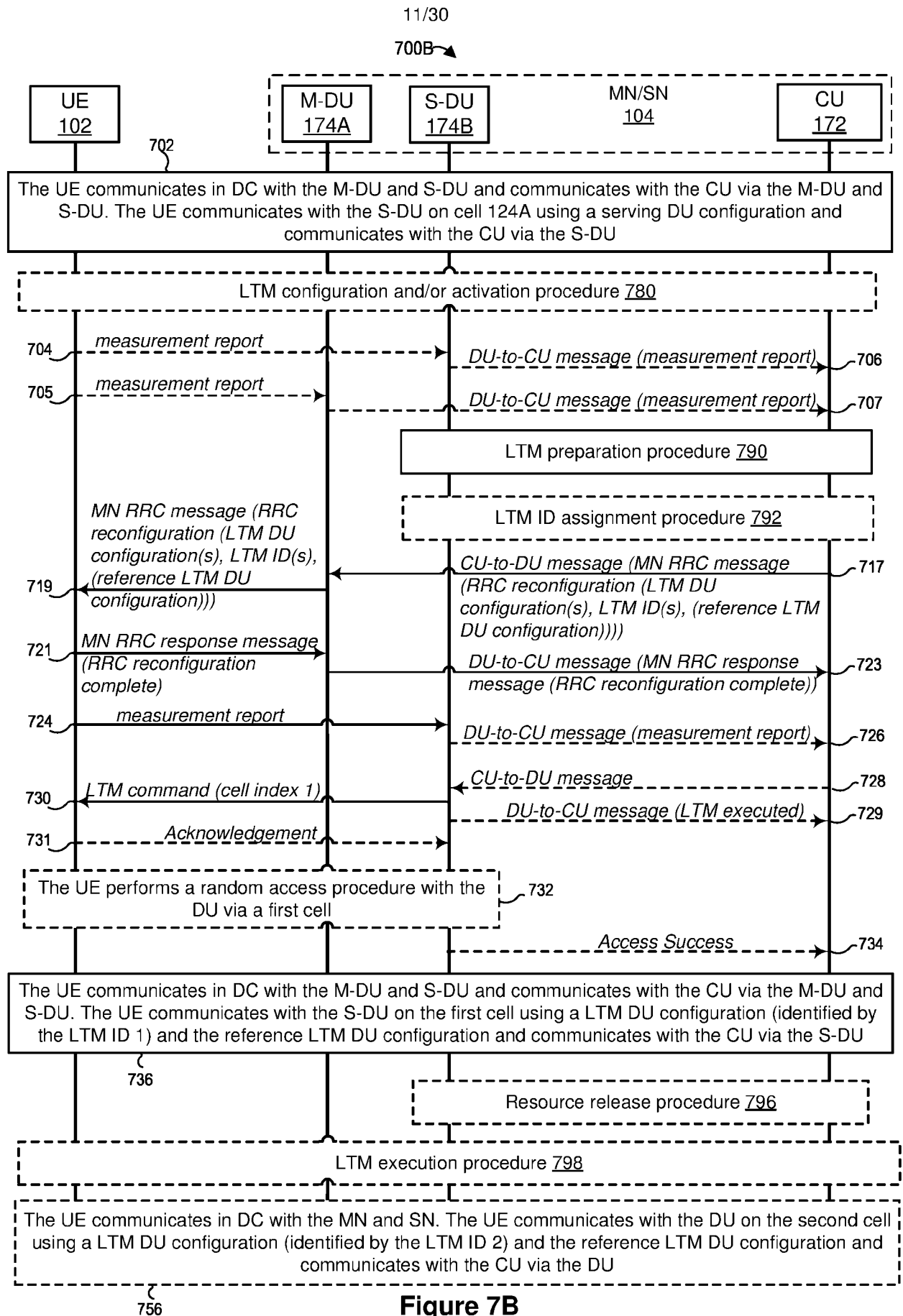


Figure 7B

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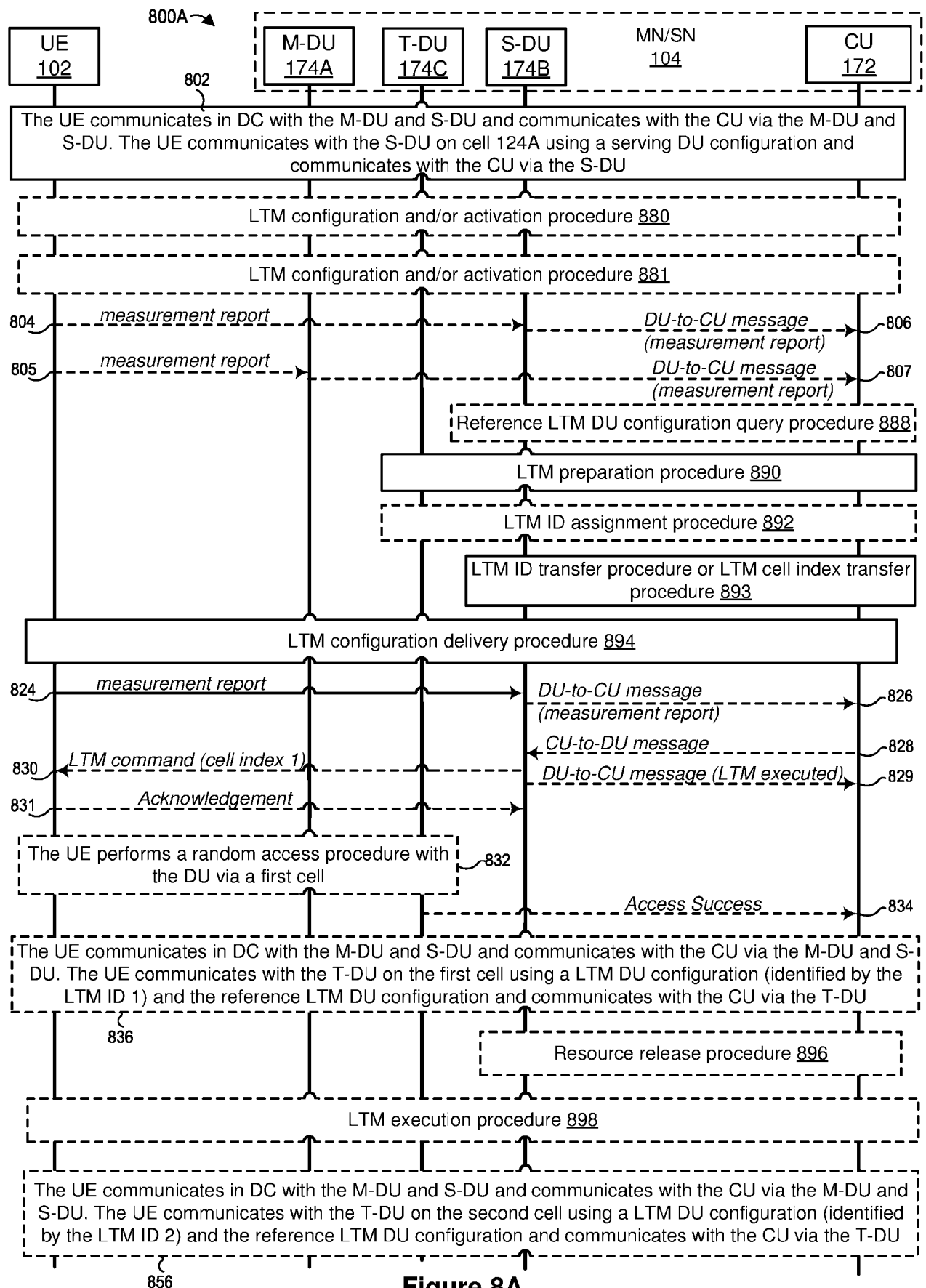
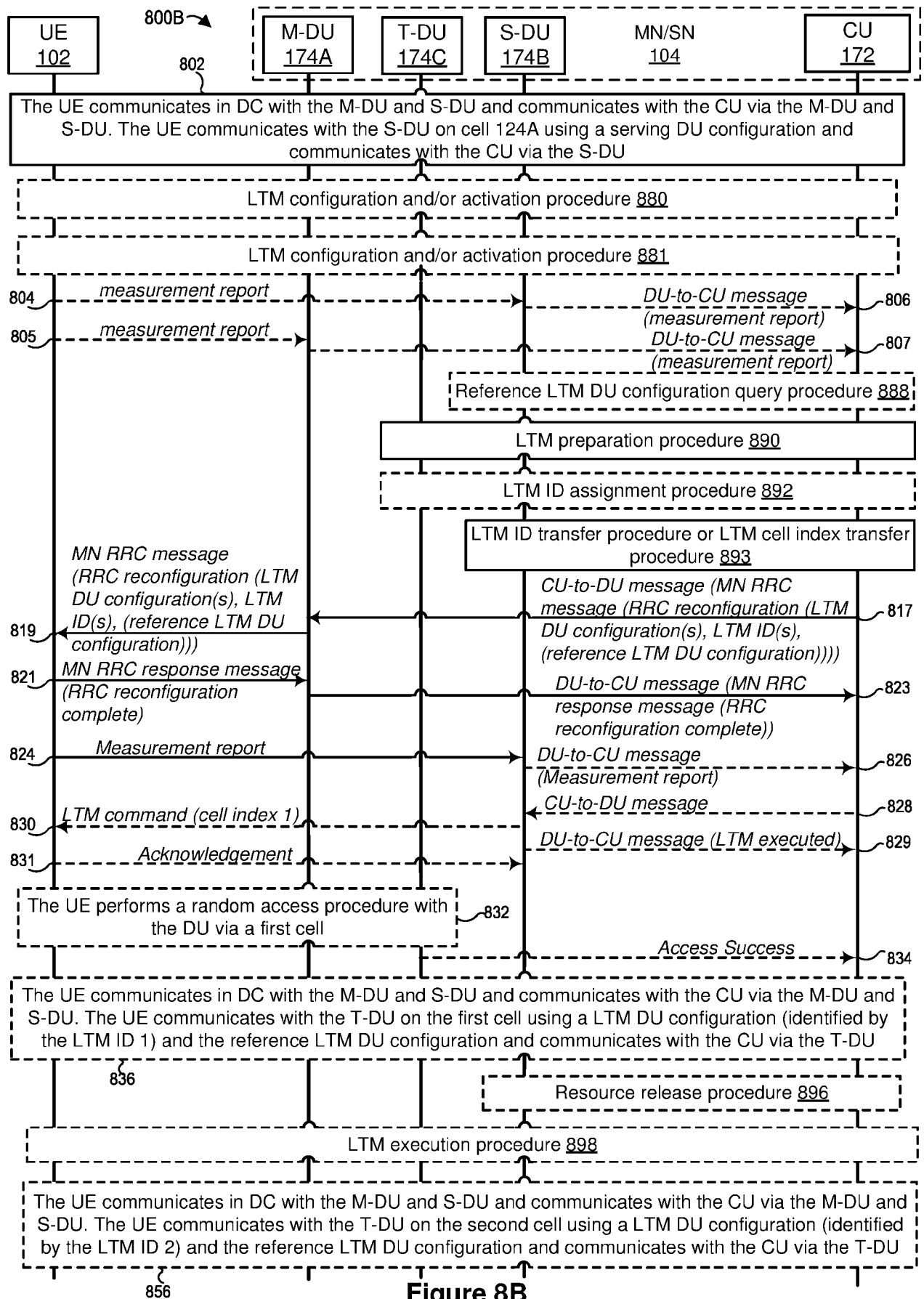
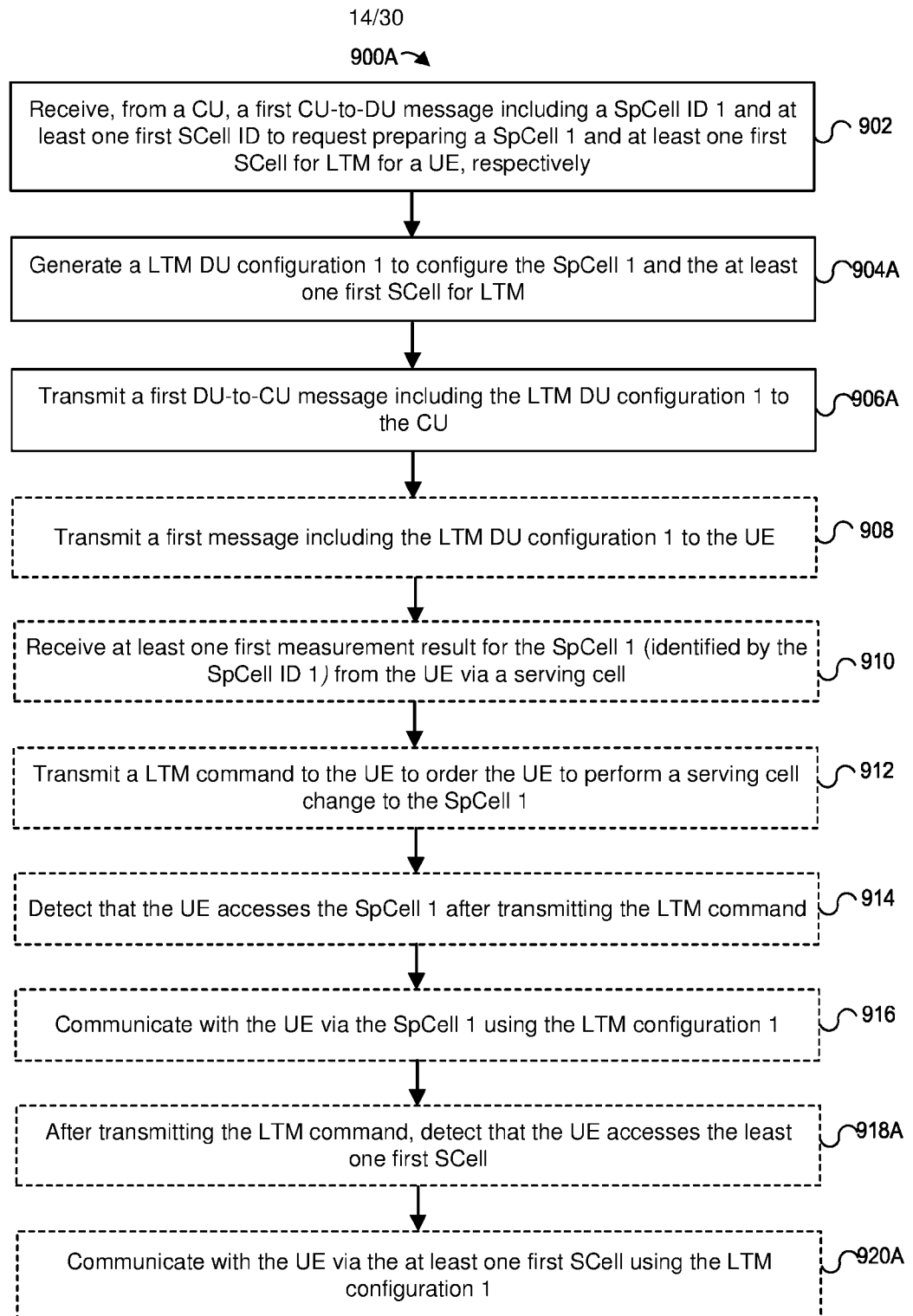


Figure 8A

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**Figure 9A**

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900B ↗

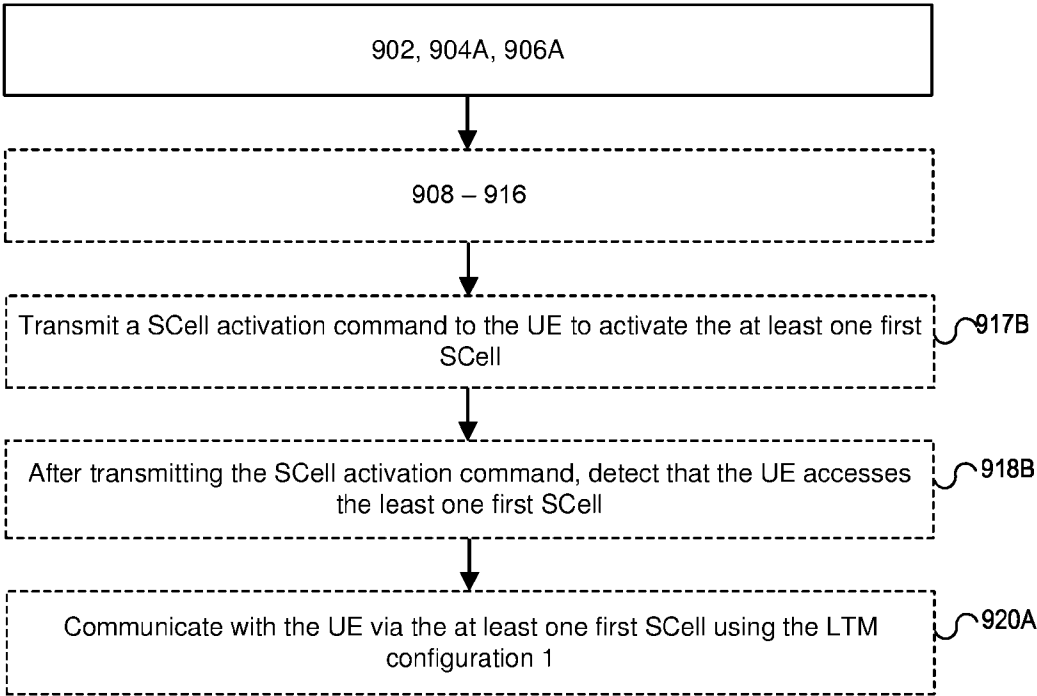
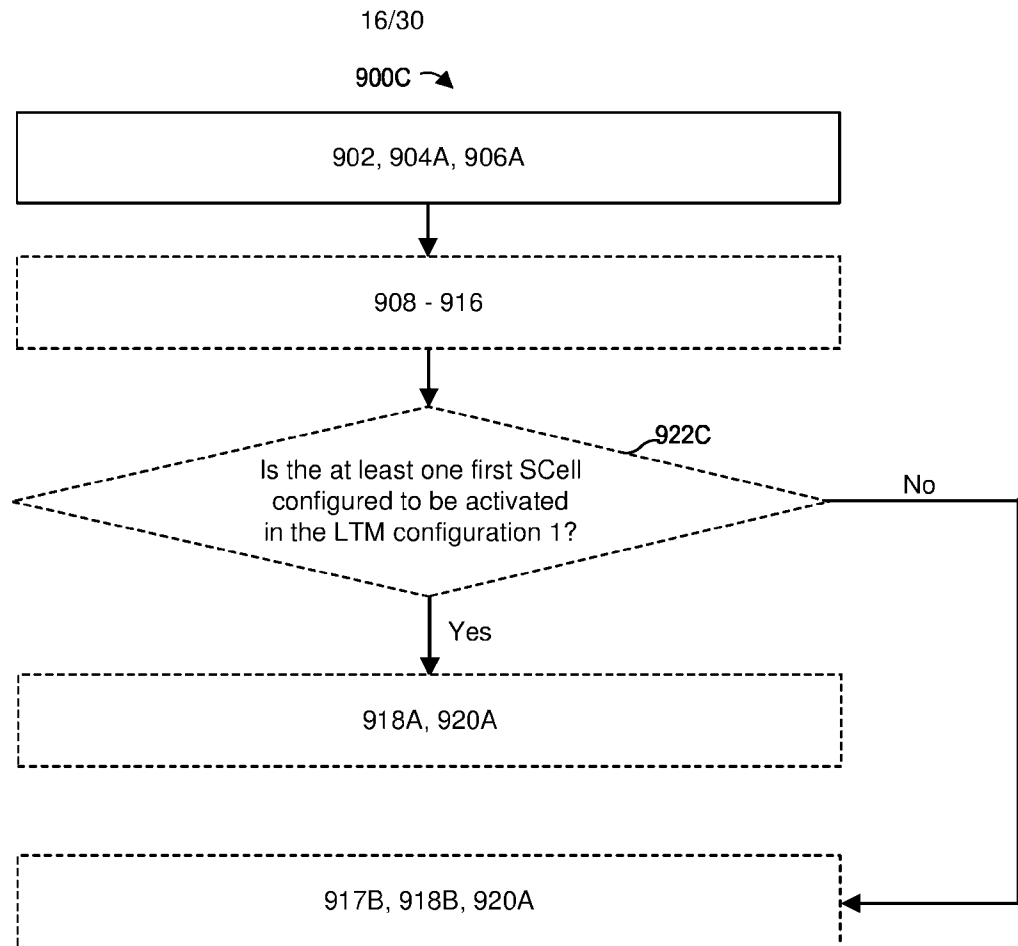
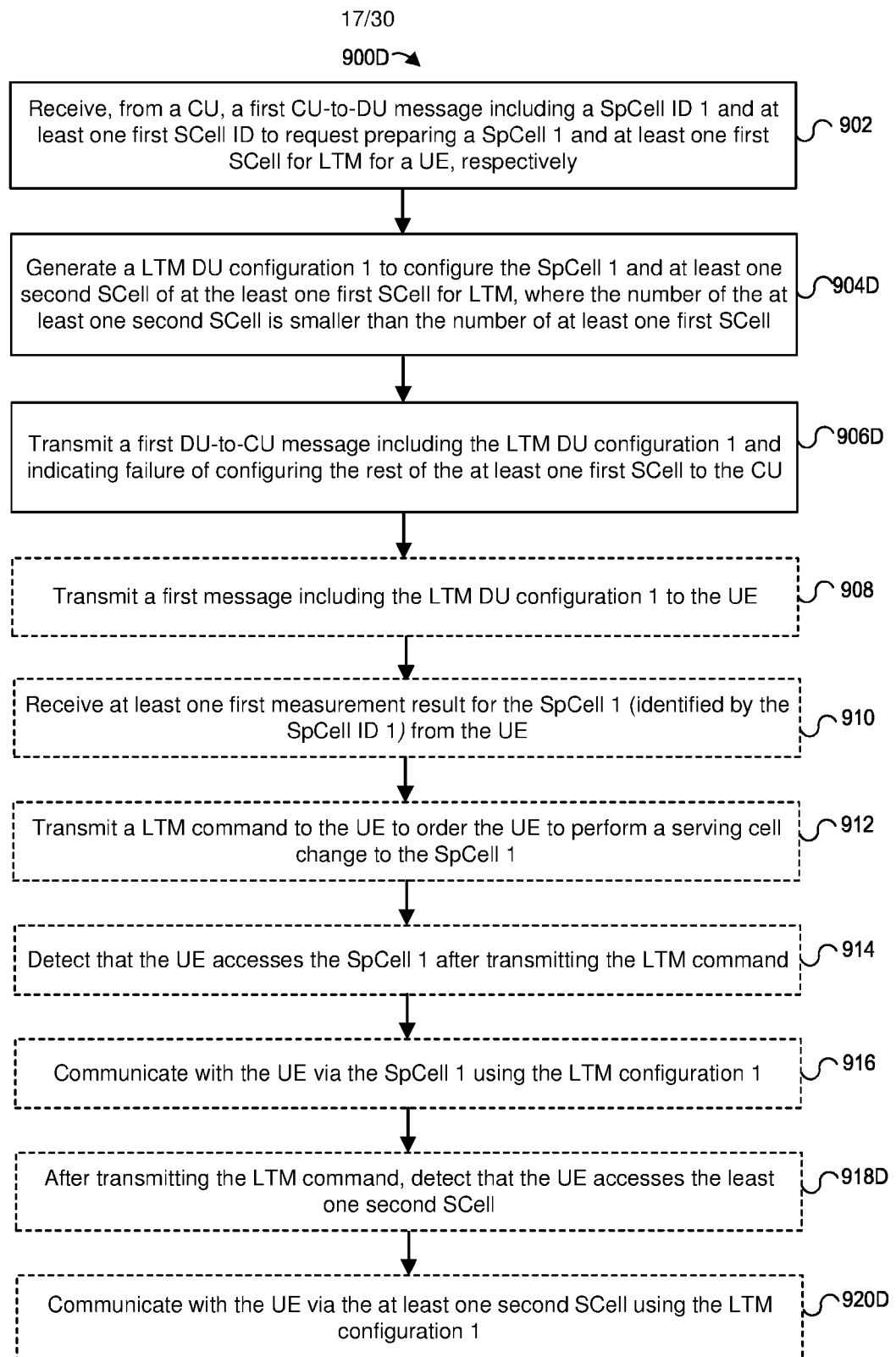


Figure 9B

**Figure 9C**

**Figure 9D**

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900E ↗

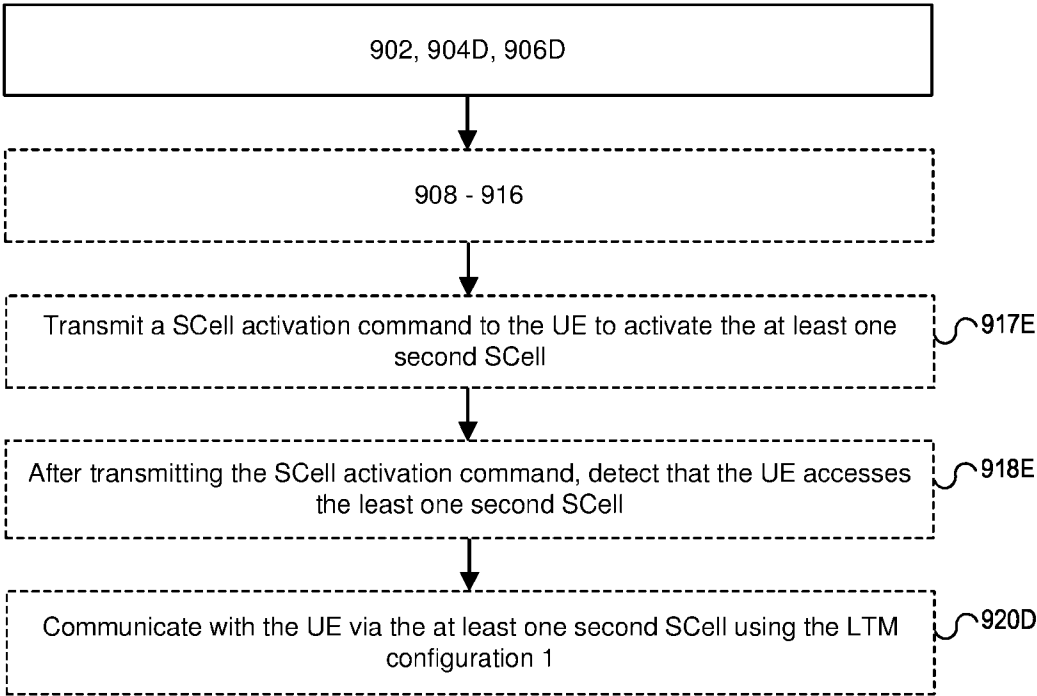
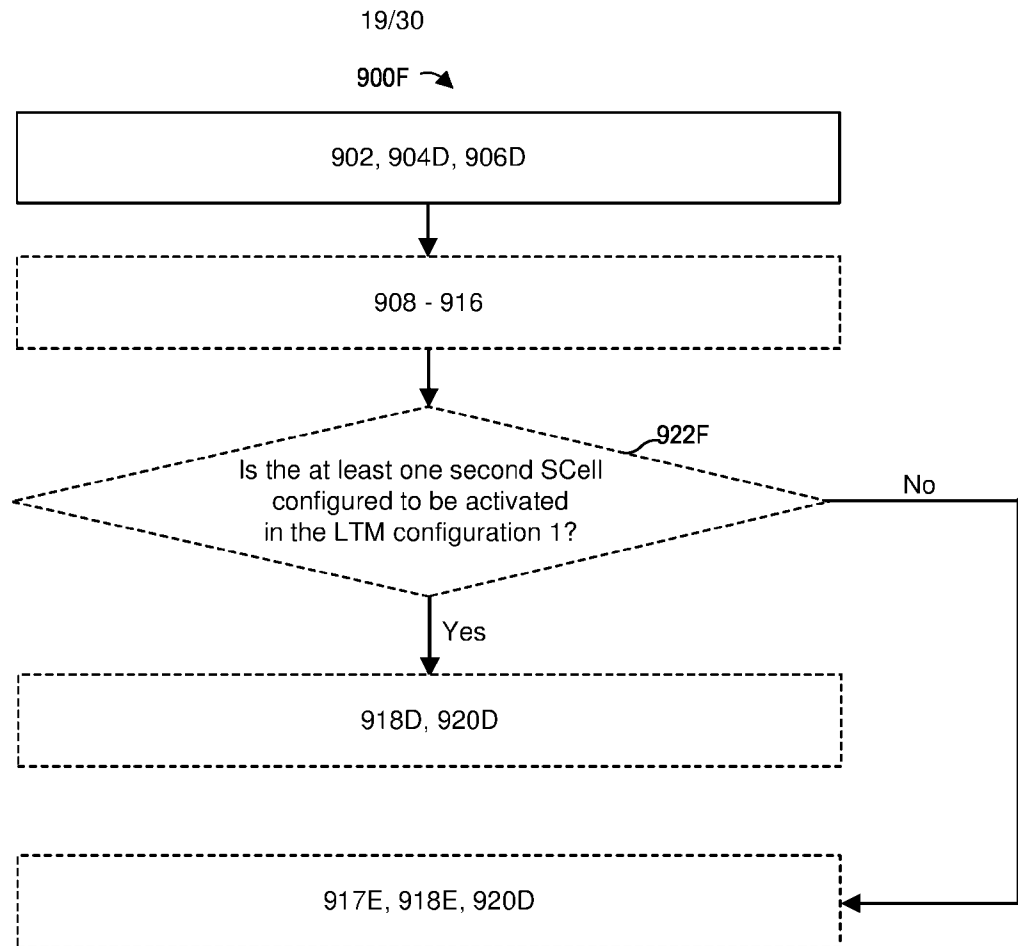
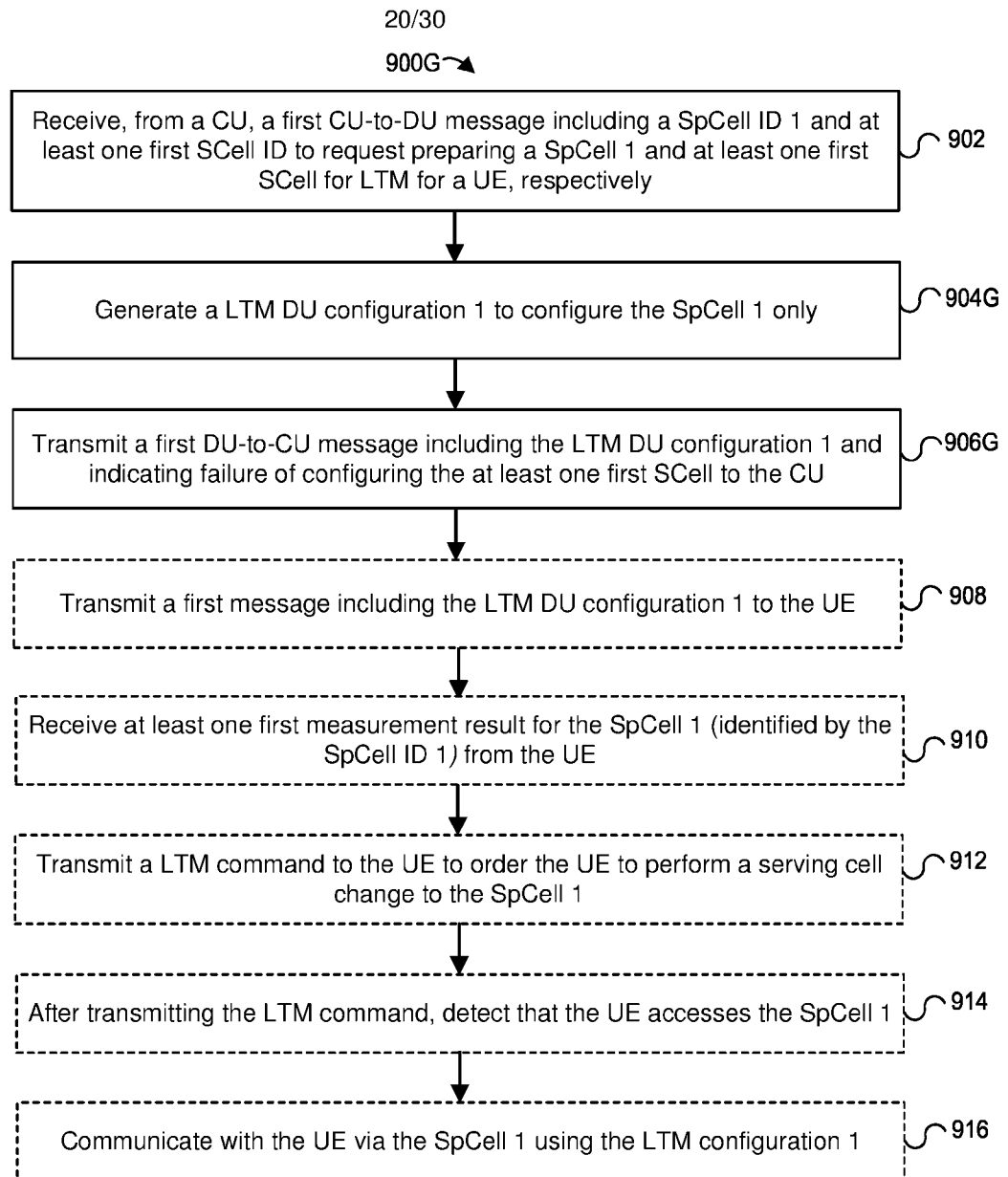
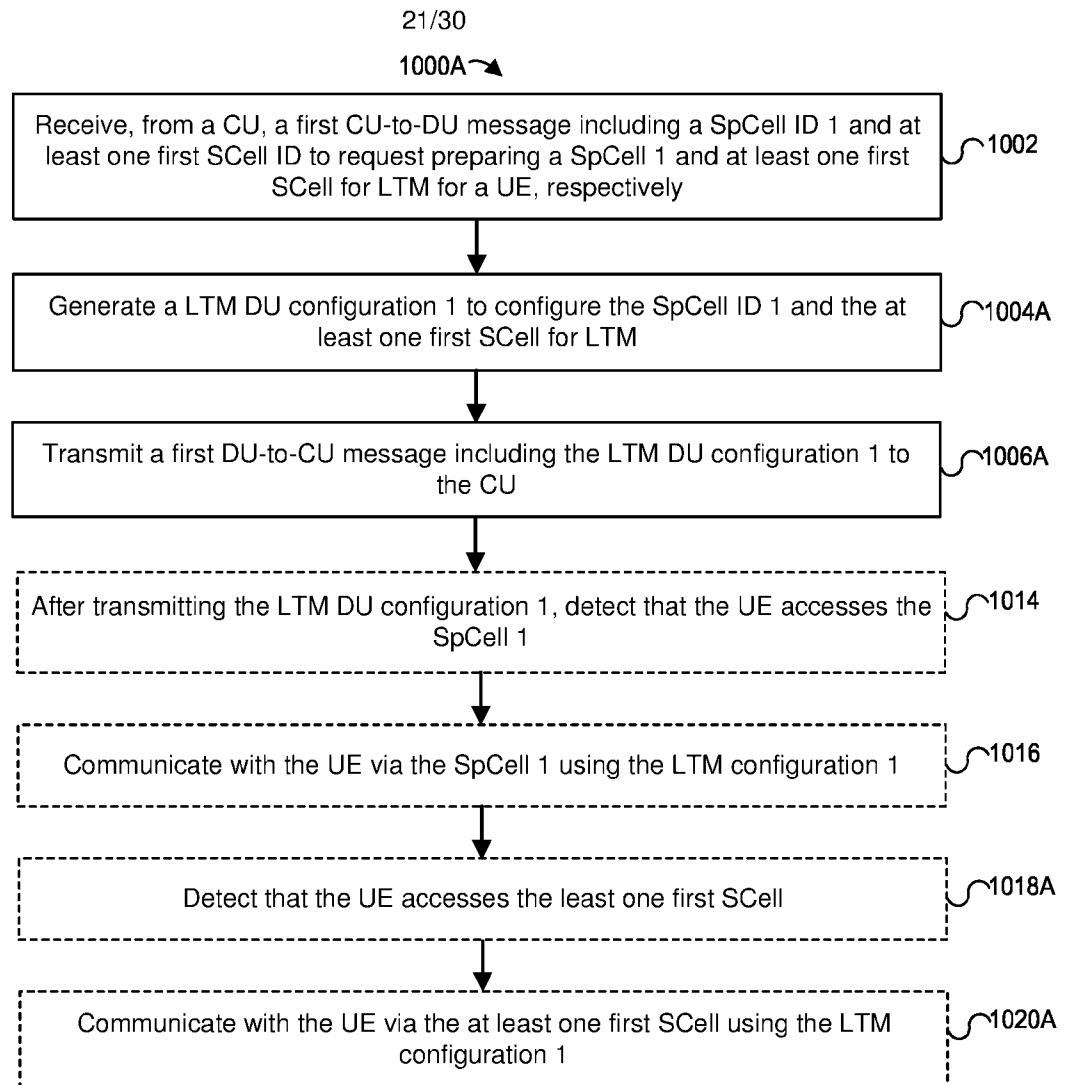


Figure 9E

**Figure 9F**

**Figure 9G**

**Figure 10A**

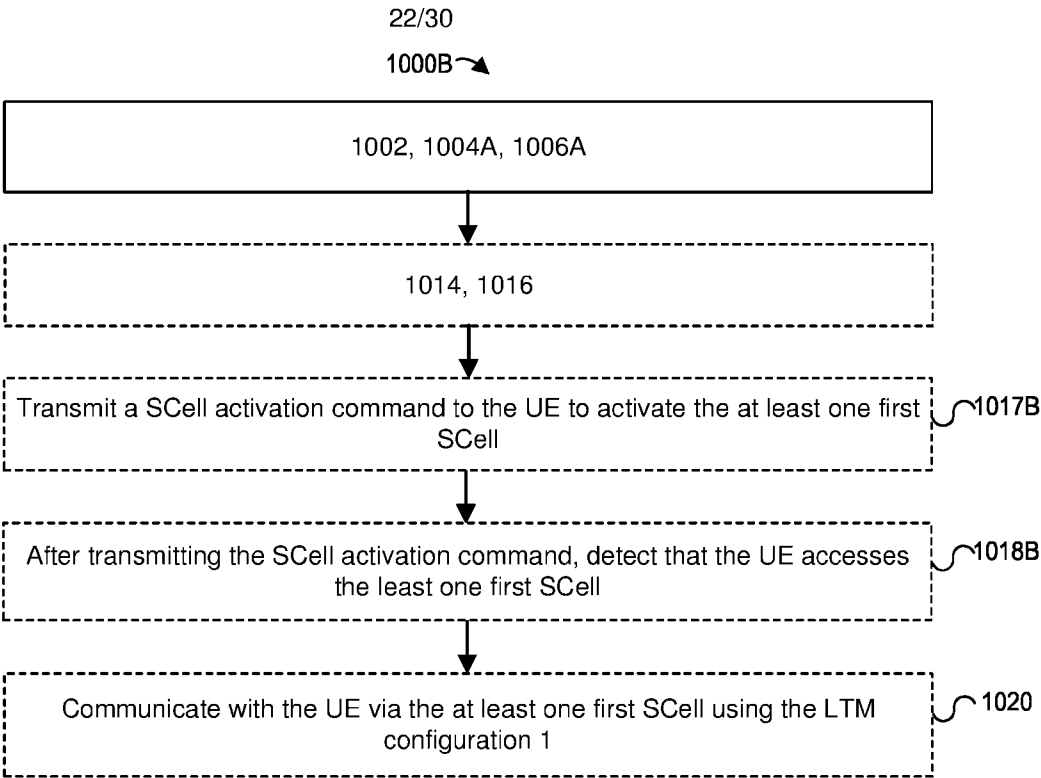
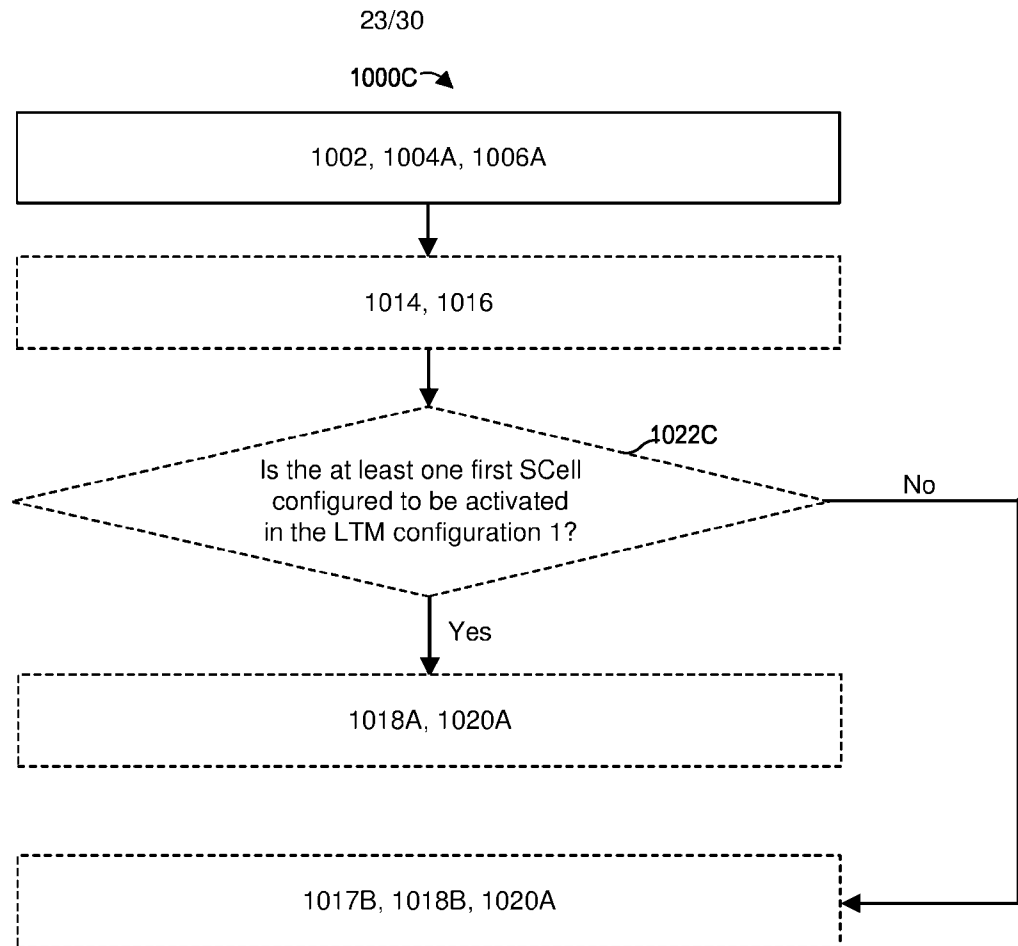


Figure 10B

**Figure 10C**

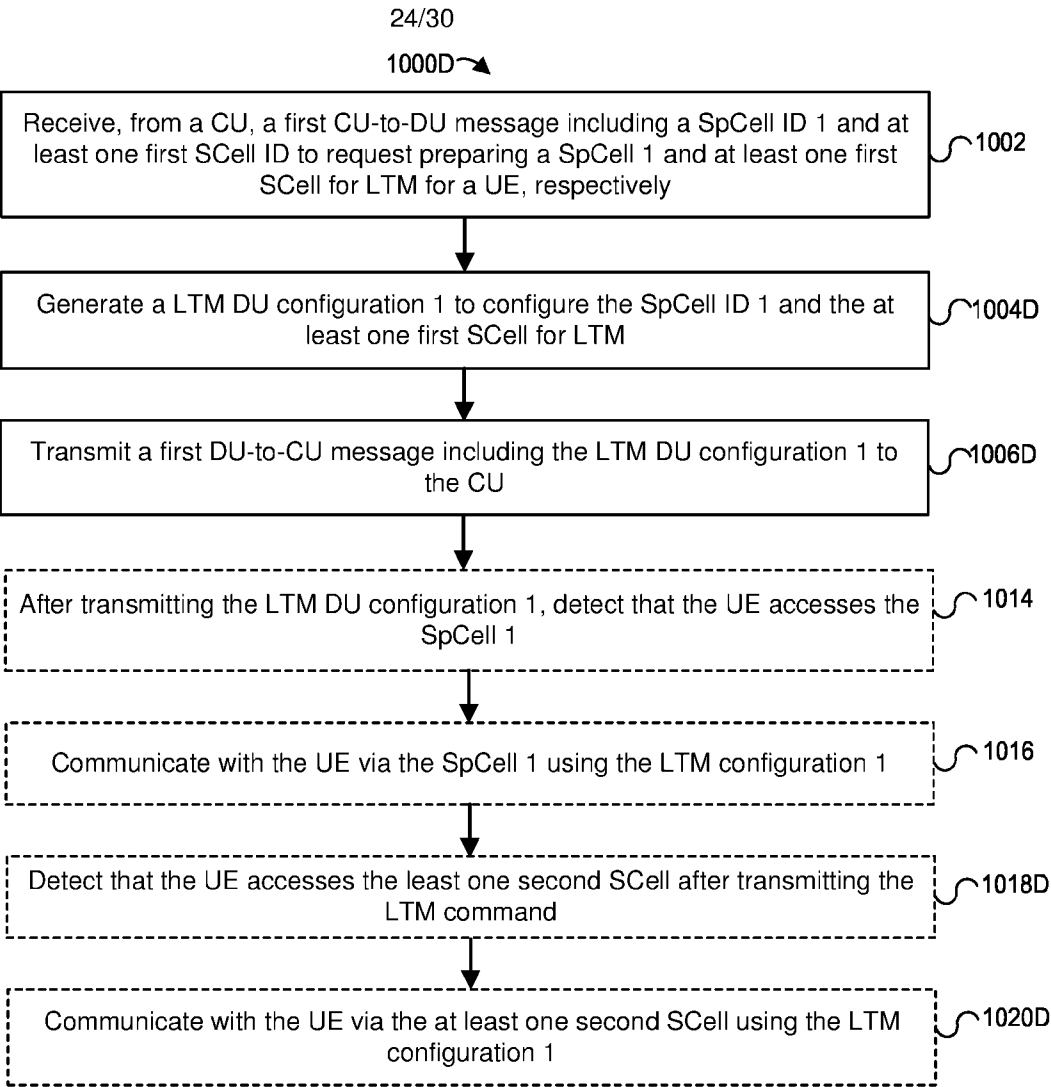


Figure 10D

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1000E ↗

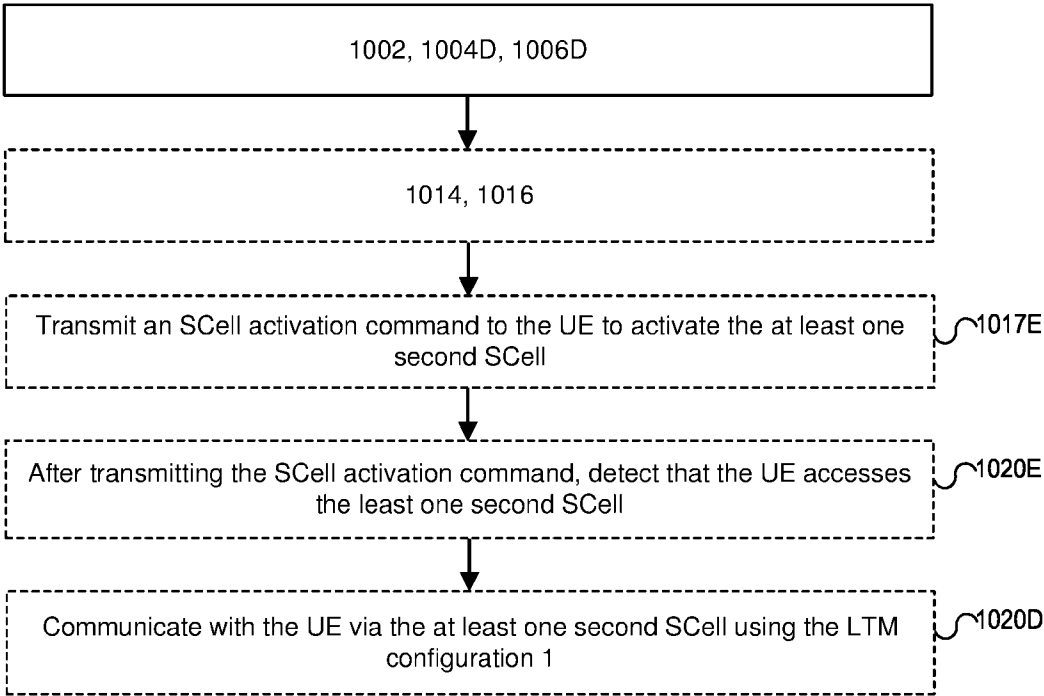
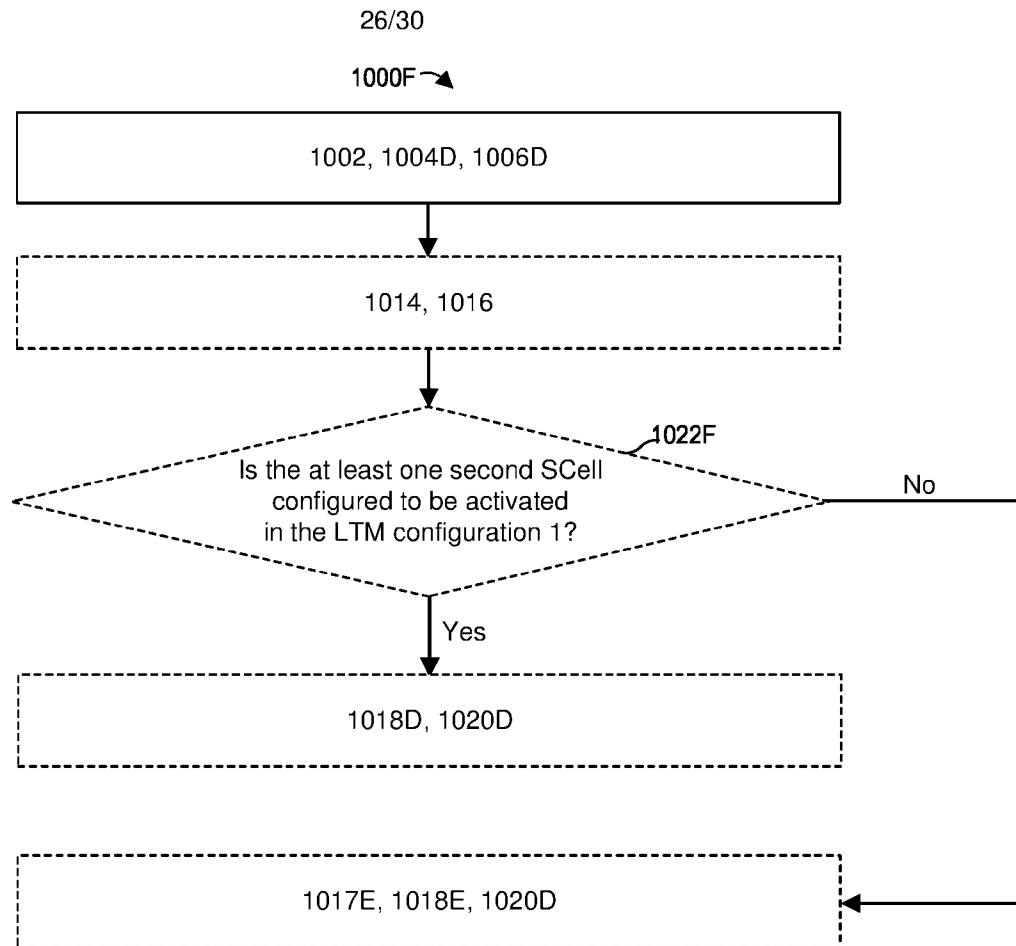
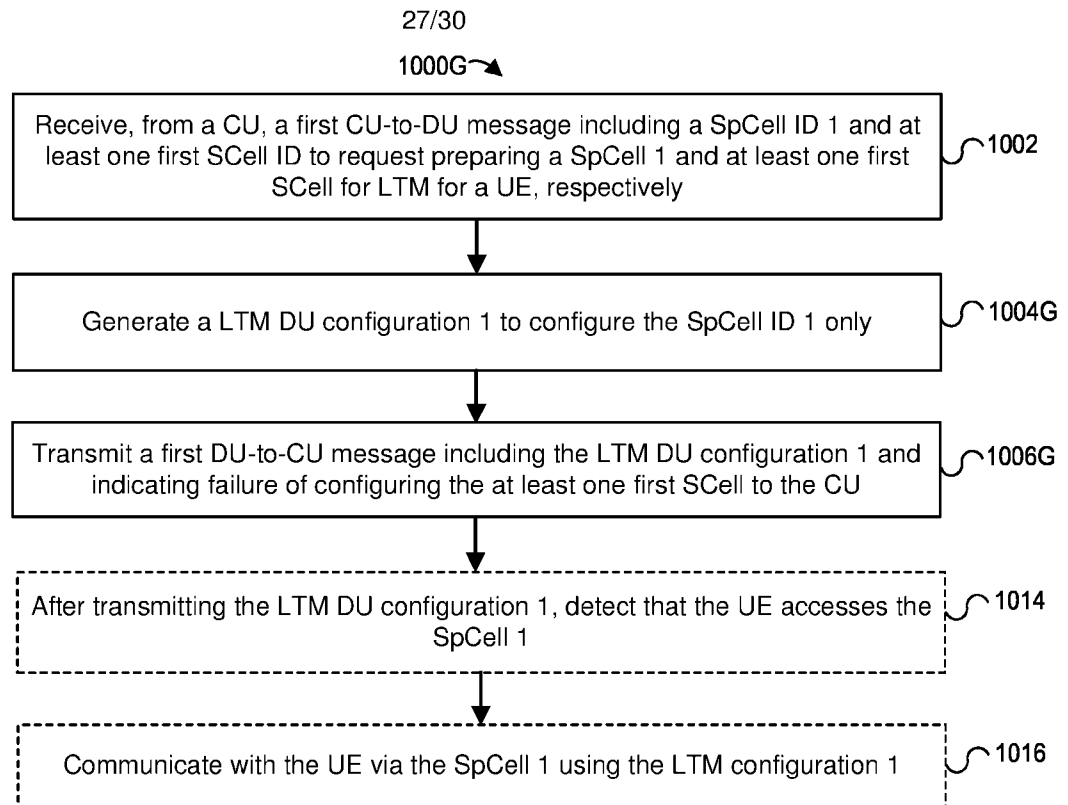
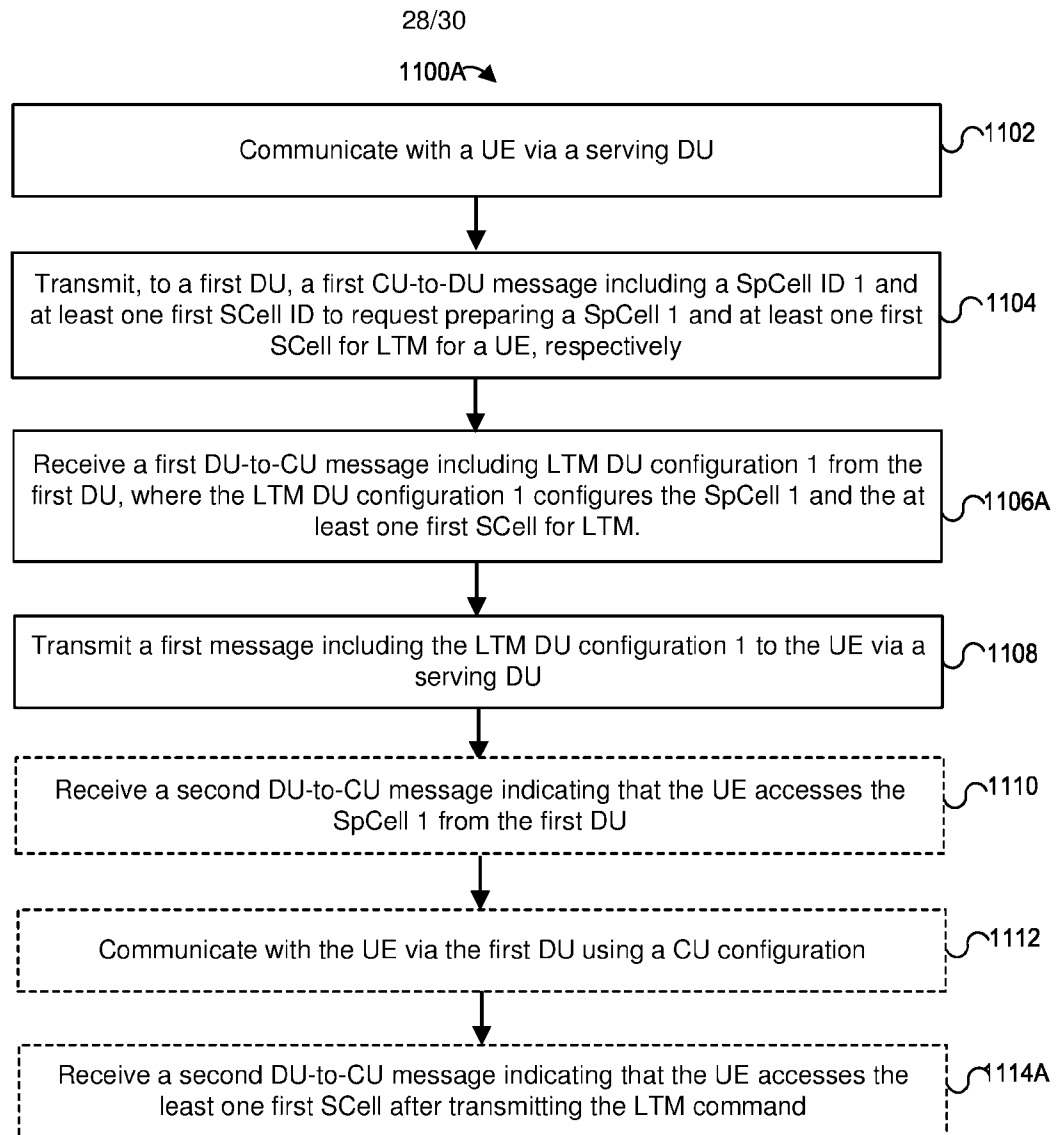
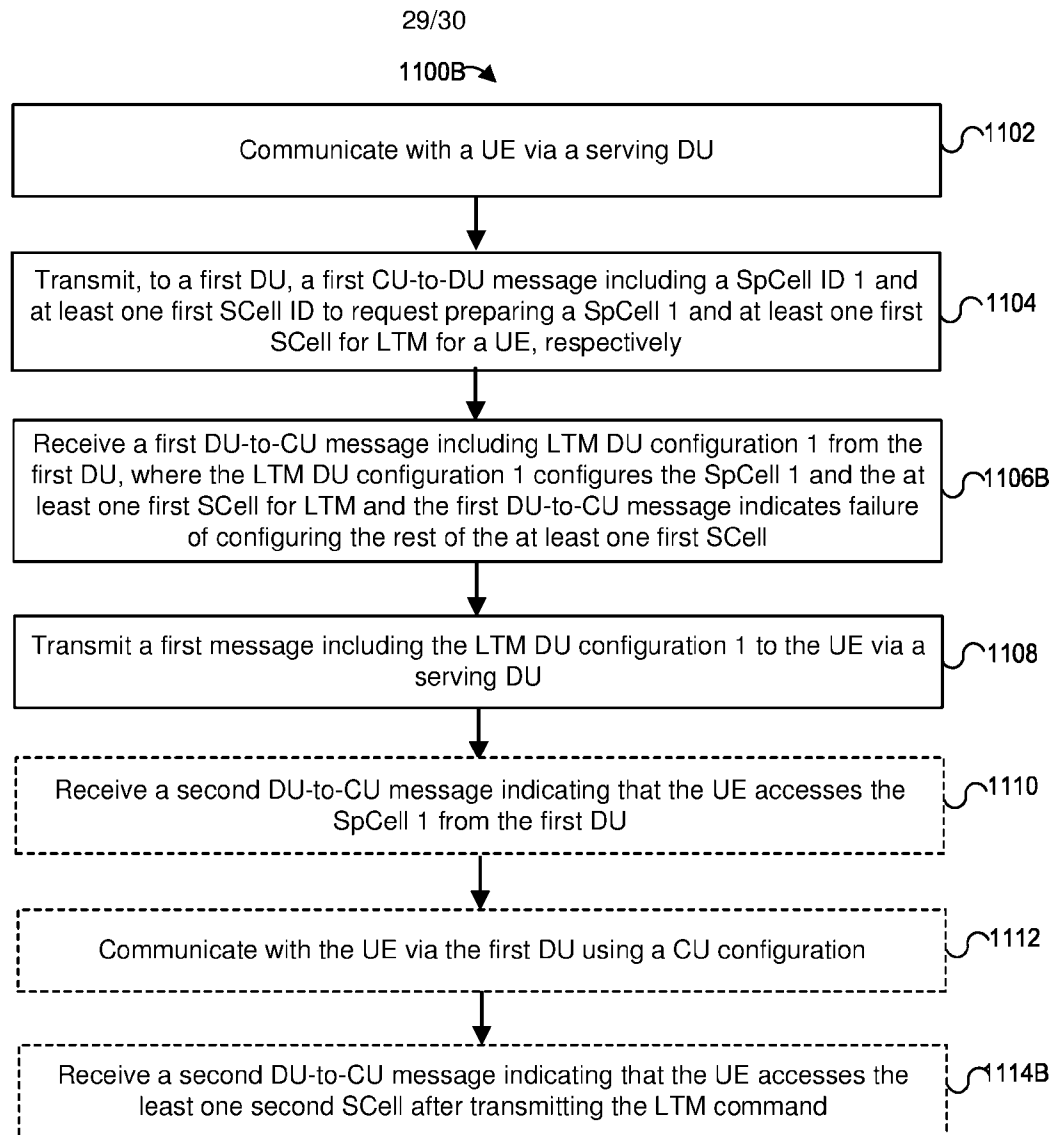


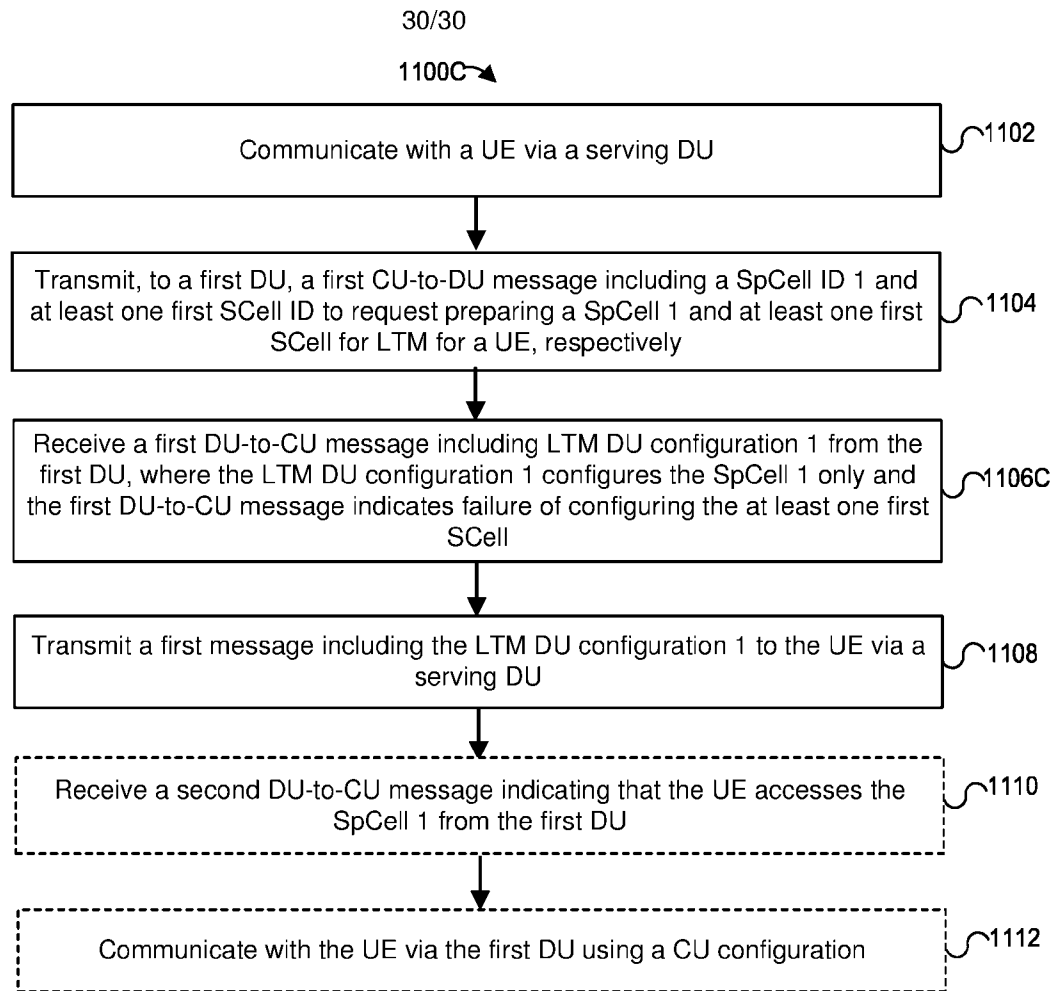
Figure 10E

**Figure 10F**

**Figure 10G**

**Figure 11A**

**Figure 11B**

**Figure 11C**

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2024/016315

A. CLASSIFICATION OF SUBJECT MATTER INV. H04L5/00 H04W36/00 ADD.		
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 H04L 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) EPO-Internal		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	LIWEI QIU ET AL: "Solutions for L1/L2 based inter-cell mobility", 3GPP DRAFT; R3-226230; TYPE DISCUSSION; NR_MOB_ENH2, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. 3GPP RAN 3, no. Toulouse, FR; 20221114 - 20221118 3 November 2022 (2022-11-03), XP052223714, Retrieved from the Internet: URL:https://www.3gpp.org/ftp/TSG_RAN/WG3_I u/TSGR3_118/Docs/R3-226230.zip R3-226230.docx [retrieved on 2022-11-03] the whole document ----- -/-	1 - 15
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
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Date of the actual completion of the international search 22 May 2024		Date of mailing of the international search report 07/06/2024
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Sorrentino, Andrea

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2024/016315

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2022/182894 A1 (DAMNJANOVIC JELENA [US] ET AL) 9 June 2022 (2022-06-09) paragraphs [0052], [0085] - [0106] -----	1 - 15
A	US 2022/014983 A1 (ZHOU YAN [US] ET AL) 13 January 2022 (2022-01-13) paragraphs [0057] - [0098] -----	1 - 15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2024/016315

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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US 2022014983 A1	13-01-2022	CN 115918163 A	04-04-2023
		EP 4179785 A1	17-05-2023
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		WO 2022015609 A1	20-01-2022