

CONDITION BASED LTM

TECHNICAL FIELD

[0001] The present disclosure relates to wireless communications, and more specifically to radio access network (RAN) units, methods, apparatuses, and computer readable medium for condition based layer 1/layer 2 triggered mobility (LTM).

BACKGROUND

[0002] A wireless communications system may include one or multiple network communication devices, such as base stations, which may be otherwise known as an eNodeB (eNB), a next-generation NodeB (gNB), or other suitable terminology. Each network communication devices, such as a base station may support wireless communications for one or multiple user communication devices, which may be otherwise known as user equipment (UE), or other suitable terminology. The wireless communications system may support wireless communications with one or multiple user communication devices by utilizing resources of the wireless communication system (e.g., time resources (e.g., symbols, slots, subframes, frames, or the like) or frequency resources (e.g., subcarriers, carriers). Additionally, the wireless communications system may support wireless communications across various radio access technologies including third generation (3G) radio access technology, fourth generation (4G) radio access technology, fifth generation (5G) radio access technology, among other suitable radio access technologies beyond 5G (e.g., sixth generation (6G)).

[0003] In the third generation partner project (3GPP), a work item on further new radio (NR) mobility enhancements, named as LTM, was approved to change a serving cell via layer 1/layer 2 (L1/L2) signalling, in order to reduce the latency, overhead, and interruption time. The LTM refers to a PCell (primary cell of a master cell group) or PSCell (primary cell of a secondary cell group) cell switch procedure that the network triggers via a medium access control (MAC) control element (CE) based on L1 measurements. LTM may be performed intra-gNB or inter-gNB, for example, a UE may be switched to a target distributed unit (DU) that belongs to a same central unit (CU) or different CUs with a source DU.

SUMMARY

[0004] The present disclosure relates to RAN units, methods, apparatuses, and computer

readable medium for condition based LTM. According to the proposed solution, enhancements for supporting the LTM are proposed.

[0005] In some implementations, there is provided a RAN CU. The RAN CU comprises at least one memory; and at least one processor coupled with the at least one memory and configured to cause the RAN CU to: transmit, to a target RAN CU, a first request message indicates condition based LTM and an LTM candidate cell associated with the condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a user equipment (UE); and receive, from the target RAN CU, a first response message comprising a first configuration for the LTM candidate cell.

[0006] In some implementations, there is provided a RAN CU. The RAN CU comprises at least one memory; and at least one processor coupled with the at least one memory and configured to cause the RAN CU to: transmit, to a target RAN DU, a second request message comprising an indication of condition based LTM and an LTM candidate cell associated with the condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a UE; and receive, from the target RAN DU, a second response message comprising a second configuration for the LTM candidate cell.

[0007] In some implementations, there is provided a target RAN CU. The target RAN CU comprises at least one memory; and at least one processor coupled with the at least one memory and configured to cause the target RAN CU to: receive, from a RAN CU, a first request message indicates condition based LTM and an LTM candidate cell associated with the condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a UE; transmit, to a target RAN DU, a second request message indicates the condition based LTM and the LTM candidate cell; receive, from the target RAN DU, a second response message comprising a second configuration associated with the LTM candidate cell; and transmit, to the RAN CU, a first response message comprising a first configuration for the LTM candidate cell, wherein the first configuration at least comprises the second configuration.

[0008] In some implementations, there is provided a target RAN DU. The target RAN DU comprises at least one memory; and at least one processor coupled with the at least one memory and configured to cause the target RAN DU to: receive, from a RAN CU or a target RAN CU, a second request message indicates condition based LTM and an LTM candidate cell associated with the condition based LTM, wherein the condition based LTM will be

performed based on an evaluation of conditions by a UE; and transmit, to the RAN CU or the target RAN CU, a second response message comprising second configuration associated with the LTM candidate cell.

[0009] In some implementations, there is provided a source RAN DU. The source RAN DU comprises at least one memory; and at least one processor coupled with the at least one memory and configured to cause the source RAN DU to: receive, from a RAN CU, a message for requesting the RAN DU to determine at least one condition for an LTM candidate cell based on layer 1 measurements, wherein the at least one condition for the LTM candidate cell based on layer 1 measurements is used for condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a UE; and determine, based on the message, the at least one condition for the LTM candidate cell based on layer 1 measurements; and transmit, to the RAN CU, the at least one condition for the LTM candidate cell based on layer 1 measurements.

[0010] In some implementations, there is provided a UE. The UE comprises at least one memory; and at least one processor coupled with the at least one memory and configured to cause the UE to: receive, from a RAN CU, a first configuration for an LTM candidate cell associated with condition based LTM and one or more corresponding conditions for triggering LTM; and in accordance with a determination that one of the one or more corresponding conditions is met, perform a switching to the LTM candidate cell.

[0011] In some implementations, there is provided a method performed by the RAN CU. The method comprises: transmitting, to a target RAN CU, a first request message indicates condition based LTM and an LTM candidate cell associated with the condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a user equipment (UE); and receiving, from the target RAN CU, a first response message comprising a first configuration for the LTM candidate cell.

[0012] In some implementations, there is provided a method performed by the RAN CU. The method comprises: transmitting, to a target RAN DU, a second request message comprising an indication of condition based LTM and an LTM candidate cell associated with the condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a UE; and receiving, from the target RAN DU, a second response message comprising a second configuration for the LTM candidate cell.

[0013] In some implementations, there is provided a method performed by the target RAN

CU. The method comprises: receiving, from a RAN CU, a first request message indicates condition based LTM and an LTM candidate cell associated with the condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a UE; transmitting, to a target RAN DU, a second request message indicates the condition based LTM and the LTM candidate cell; receiving, from the target RAN DU, a second response message comprising a second configuration associated with the LTM candidate cell; and transmitting, to the RAN CU, a first response message comprising a first configuration for the LTM candidate cell, wherein the first configuration at least comprises the second configuration.

[0014] In some implementations, there is provided a method performed by the target RAN DU. The method comprises: receiving, from a RAN CU or a target RAN CU, a second request message indicates condition based LTM and an LTM candidate cell associated with the condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a UE; and transmitting, to the RAN CU or the target RAN CU, a second response message comprising second configuration associated with the LTM candidate cell.

[0015] In some implementations, there is provided a method performed by the source RAN DU. The method comprises: receiving, from a RAN CU, a message for requesting the RAN DU to determine at least one condition for an LTM candidate cell based on layer 1 measurements, wherein the at least one condition for the LTM candidate cell based on layer 1 measurements is used for condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a UE; and determining, based on the message, the at least one condition for the LTM candidate cell based on layer 1 measurements; and transmitting, to the RAN CU, the at least one condition for the LTM candidate cell based on layer 1 measurements.

[0016] In some implementations, there is provided a method performed by the UE. The method comprises: receiving, from a RAN CU, a first configuration for an LTM candidate cell associated with condition based LTM and one or more corresponding conditions for triggering LTM; and in accordance with a determination that one of the one or more corresponding conditions is met, performing a switching to the LTM candidate cell.

[0017] In some implementations, there is provided a processor for wireless communication. The processor comprises at least one controller coupled with at least one memory and

configured to cause the processor to: transmit, to a target RAN CU, a first request message indicates condition based LTM and an LTM candidate cell associated with the condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a UE; and receive, from the target RAN CU, a first response message comprising a first configuration for the LTM candidate cell.

[0018] In some implementations, there is provided a processor for wireless communication. The processor comprises at least one controller coupled with at least one memory and configured to cause the processor to: transmit, to a target RAN DU, a second request message comprising an indication of condition based LTM and an LTM candidate cell associated with the condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a UE; and receive, from the target RAN DU, a second response message comprising a second configuration for the LTM candidate cell.

[0019] In some implementations, there is provided a processor for wireless communication. The processor comprises at least one controller coupled with at least one memory and configured to cause the processor to: receive, from a RAN CU, a first request message indicates condition based LTM and an LTM candidate cell associated with the condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a UE; transmit, to a target RAN DU, a second request message indicates the condition based LTM and the LTM candidate cell; receive, from the target RAN DU, a second response message comprising a second configuration associated with the LTM candidate cell; and transmit, to the RAN CU, a first response message comprising a first configuration for the LTM candidate cell, wherein the first configuration at least comprises the second configuration.

[0020] In some implementations, there is provided a processor for wireless communication. The processor comprises at least one controller coupled with at least one memory and configured to cause the processor to: receive, from a RAN CU or a target RAN CU, a second request message indicates condition based LTM and an LTM candidate cell associated with the condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a UE; and transmit, to the RAN CU or the target RAN CU, a second response message comprising second configuration associated with the LTM candidate cell.

[0021] In some implementations, there is provided a processor for wireless communication.

The processor comprises at least one controller coupled with at least one memory and configured to cause the processor to: receive, from a RAN CU, a message for requesting the RAN DU to determine at least one condition for an LTM candidate cell based on layer 1 measurements, wherein the at least one condition for the LTM candidate cell based on layer 1 measurements is used for condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a UE; and determine, based on the message, the at least one condition for the LTM candidate cell based on layer 1 measurements; and transmit, to the RAN CU, the at least one condition for the LTM candidate cell based on layer 1 measurements.

[0022] In some implementations, there is provided a processor for wireless communication. The processor comprises at least one controller coupled with at least one memory and configured to cause the processor to: receive, from a RAN CU, a first configuration for an LTM candidate cell associated with condition based LTM and one or more corresponding conditions for triggering LTM; and in accordance with a determination that one of the one or more corresponding conditions is met, perform a switching to the LTM candidate cell.

[0023] In some implementations of the methods and the RAN CU described herein, further comprising: transmitting, to the UE, the first configuration for the LTM candidate cell and one or more corresponding conditions for triggering LTM.

[0024] In some implementations of the methods and the RAN CU described herein, further comprising: generating a condition for the LTM candidate cell based on layer 3 measurements, wherein the one or more corresponding conditions comprise the condition for the LTM candidate cell based on layer 3 measurements.

[0025] In some implementations of the methods and the RAN CU described herein, further comprising: transmitting, to a RAN DU, a message for requesting the RAN DU to determine at least one condition for the LTM candidate cell based on layer 1 measurements; and receiving, from the RAN DU, the at least one condition, wherein the one or more corresponding conditions comprise the at least one condition for the LTM candidate cell based on layer 1 measurements.

[0026] In some implementations of the methods and the RAN CU described herein, further comprising: receiving, from the UE via a RAN DU, information indicating one of: a condition is met, or a selected beam for the LTM candidate cell.

[0027] In some implementations of the methods and the RAN CU described herein, further

comprising: receiving, from the target RAN CU, a first cancel indication indicating that the LTM candidate cell configured for the condition based LTM is cancelled.

[0028] In some implementations of the methods and the RAN CU described herein, further comprising: determining to cancel the LTM candidate cell configured for the condition based LTM; and transmitting, to the target RAN CU, a second cancel indication indicating that the LTM candidate cell configured for the condition based LTM is cancelled.

[0029] In some implementations of the methods and the RAN CU described herein, the first response message further indicates a random access channel (RACH) resource for an early timing advance (TA) acquisition, further comprising: selecting, for a RAN DU, some of the RACH resource for the early TA acquisition; and transmitting, to the RAN DU, configuration information indicating the some of the RACH resource for the early TA acquisition.

[0030] In some implementations of the method and the target RAN CU described herein, further comprising: determining to cancel the LTM candidate cell configured for the condition based LTM; and transmitting, to the RAN CU, a first cancel indication indicating that the LTM candidate cell configured for the condition based LTM is cancelled.

[0031] In some implementations of the method and the target RAN CU described herein, further comprising: receiving, from the RAN CU, a second cancel indication indicating that the LTM candidate cell configured for the condition based LTM is cancelled; and transmitting, to the target RAN DU, a third cancel indication indicating that the LTM candidate cell is cancelled by the RAN CU.

[0032] In some implementations of the method and the target RAN DU described herein, further comprising: receiving, from the RAN CU or the target RAN CU, a cancel indication indicating that the LTM candidate cell configured for the condition based LTM is cancelled.

[0033] In some implementations of the method and the RAN DU described herein, further comprising: receiving, from the RAN CU, some of random access channel (RACH) resource for an early TA acquisition, wherein the RACH resource for the early TA acquisition is determined by a target RAN DU for the RAN CU.

[0034] In some implementations of the method and the UE described herein, further comprising: transmitting, to the RAN CU via the RAN DU, information indicating one of: the condition is met, or a selected beam for the LTM candidate cell.

[0035] In some implementations of the method and the UE described herein, further

comprising: in accordance with a determination that the condition is met for both the LTM candidate cell and a further LTM candidate cell, determining to switch to the LTM candidate cell based on a higher priority of the LTM candidate cell.

[0036] In some implementations of the method and the UE described herein, further comprising: performing an early timing advance (TA) acquisition based on a physical downlink control channel (PDCCH) order or based on a UE based TA measurement.

[0037] In some implementations of the method and the UE described herein, further comprising: receiving, from the RAN CU or a RAN DU, a cell switching command for triggering a cell switching; and performing a switching to the LTM candidate cell based on the cell switching command even though none of the one or more corresponding conditions is met.

[0038] In some implementations of the methods, the RAN CU, the RAN DU, and the UE described herein, the first request message further indicates whether at least one subsequent LTM is supported by condition based LTM.

[0039] In some implementations of the methods, the RAN CU, the RAN DU, and the UE described herein, the first request message further comprises information of a RAN DU, and the first request message further requests for a RACH resource for an early TA acquisition associated with the RAN DU.

[0040] In some implementations of the methods, the RAN CU, the RAN DU, and the UE described herein, the second request message further indicates one of: an estimated probability for arrival toward the LTM candidate cell associated with the condition based LTM, or whether the estimated probability is applied for at least one subsequent LTM.

[0041] In some implementations of the methods, the RAN CU, the RAN DU, and the UE described herein, the second request message further requests for a RACH resource for an early TA acquisition associated with the RAN CU, and wherein the second response message further indicates the RACH resource for an early TA acquisition associated with the RAN CU.

[0042] In some implementations of the methods, the RAN CU, the RAN DU, and the UE described herein, the first request message further comprises information of a RAN DU, and the first request message further requests for a RACH resource for an early TA acquisition associated with the RAN DU, and wherein the second response message further indicates the RACH resource for an early TA acquisition associated with the RAN DU.

BRIEF DESCRIPTION OF THE DRAWINGS

[0043] FIG. 1 illustrates an example of a wireless communications system in which some embodiments of the present disclosure can be implemented;

[0044] FIG. 2 illustrates a schematic diagram of an example communication network in which some embodiments of the present disclosure can be implemented;

[0045] FIG. 3 illustrates a signalling chart illustrating communication process for inter-CU condition based LTM in accordance with some example embodiments of the present disclosure;

[0046] FIG. 4 illustrates a signalling chart illustrating communication process for intra-CU condition based LTM in accordance with some example embodiments of the present disclosure;

[0047] FIG. 5 illustrates a signalling chart illustrating communication process for determining RACH resource for early TA acquisition for inter-CU LTM in accordance with some example embodiments of the present disclosure;

[0048] FIG. 6 illustrates an example of a device that is suitable for implementing embodiments of the present disclosure;

[0049] FIG. 7 illustrates an example of a processor that is suitable for implementing some embodiments of the present disclosure;

[0050] FIG. 8 illustrates a flowchart of an example method implemented at a RAN CU in accordance with aspects of the present disclosure;

[0051] FIG. 9 illustrates a flowchart of an example method implemented at a RAN CU in accordance with aspects of the present disclosure;

[0052] FIG. 10 illustrates a flowchart of an example method implemented at a target RAN CU in accordance with aspects of the present disclosure;

[0053] FIG. 11 illustrates a flowchart of an example method implemented at a target RAN DU in accordance with aspects of the present disclosure;

[0054] FIG. 12 illustrates a flowchart of an example method implemented at a source RAN DU in accordance with aspects of the present disclosure; and

[0055] FIG. 13 illustrates a flowchart of an example method implemented at a UE in accordance with aspects of the present disclosure.

[0056] Throughout the drawings, the same or similar reference numerals represent the same or similar element.

DETAILED DESCRIPTION

[0057] Principles of the present disclosure will now be described with reference to some embodiments. It is to be understood that these embodiments are described only for the purpose of illustration and help those skilled in the art to understand and implement the present disclosure, without suggesting any limitation as to the scope of the disclosure. The disclosure described herein can be implemented in various manners other than the ones described below. In the following description and claims, unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skills in the art to which this disclosure belongs.

[0058] References in the present disclosure to “one embodiment,” “an example embodiment,” “an embodiment,” “some embodiments,” and the like indicate that the embodiment(s) described may include a particular feature, structure, or characteristic, but it is not necessary that every embodiment includes the particular feature, structure, or characteristic. Moreover, such phrases do not necessarily refer to the same embodiment(s). Further, when a particular feature, structure, or characteristic is described in connection with an embodiment, it is submitted that it is within the knowledge of one skilled in the art to affect such feature, structure, or characteristic in connection with other embodiments whether or not explicitly described.

[0059] It shall be understood that although the terms “first” and “second” or the like may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another element. For example, a first element could also be termed as a second element, and similarly, a second element could also be termed as a first element, without departing from the scope of embodiments. As used herein, the term “and/or” includes any and all combinations of one or more of the listed terms. In some examples, values, procedures, or apparatuses are referred to as “best,” “lowest,” “highest,” “minimum,” “maximum,” or the like. It will be appreciated that such descriptions are intended to indicate that a selection among many used functional alternatives can be made, and such selections need not be better, smaller, higher, or otherwise preferable to other selections.

[0060] The terminology used herein is for the purpose of describing particular embodiments

only and is not intended to be limiting of embodiments. As used herein, the singular forms “a,” “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms “comprises,” “comprising,” “has,” “having,” “includes” and/or “including,” when used herein, specify the presence of stated features, elements, components and/or the like, but do not preclude the presence or addition of one or more other features, elements, components and/or combinations thereof. For example, the term “includes” and its variants are to be read as open terms that mean “includes, but is not limited to.” The term “based on” is to be read as “based at least in part on.” The term “one embodiment” and “an embodiment” are to be read as “at least one embodiment.” The term “another embodiment” is to be read as “at least one other embodiment.” The use of an expression such as “A and/or B” can mean either “only A” or “only B” or “both A and B.” Other definitions, explicit and implicit, may be included below.

[0061] FIG. 1 illustrates an example of a wireless communications system 100 in which some embodiments of the present disclosure can be implemented. The wireless communications system 100 may include one or more network entities 102 (also referred to as network equipment (NE)), one or more UEs 104, a core network 106, and a packet data network 108. The wireless communications system 100 may support various radio access technologies. In some implementations, the wireless communications system 100 may be a 4G network, such as a long term evolution (LTE) network or an LTE-Advanced (LTE-A) network. In some other implementations, the wireless communications system 100 may be a 5G network, such as a new radio (NR) network. In other implementations, the wireless communications system 100 may be a combination of a 4G network and a 5G network, or other suitable radio access technology including Institute of Electrical and Electronics Engineers (IEEE) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20. The wireless communications system 100 may support radio access technologies beyond 5G. Additionally, the wireless communications system 100 may support technologies, such as time division multiple access (TDMA), frequency division multiple access (FDMA), or code division multiple access (CDMA), etc.

[0062] The one or more network entities 102 may be dispersed throughout a geographic region to form the wireless communications system 100. One or more of the network entities 102 described herein may be or include or may be referred to as a network node, a base station, a network element, a radio access network (RAN), a base transceiver station, an access point, a NodeB, an eNodeB (eNB), a next-generation NodeB (gNB), or other suitable

terminology. A network entity 102 and a UE 104 may communicate via a communication link 110, which may be a wireless or wired connection. For example, a network entity 102 and a UE 104 may perform wireless communication (e.g., receive signaling, transmit signaling) over a Uu interface.

[0063] A network entity 102 may provide a geographic coverage area 112 for which the network entity 102 may support services (e.g., voice, video, packet data, message, broadcast, etc.) for one or more UEs 104 within the geographic coverage area 112. For example, a network entity 102 and a UE 104 may support wireless communication of signals related to services (e.g., voice, video, packet data, messaging, broadcast, etc.) according to one or multiple radio access technologies. In some implementations, a network entity 102 may be moveable, for example, a satellite associated with a non-terrestrial network. In some implementations, different geographic coverage areas 112 associated with the same or different radio access technologies may overlap, but the different geographic coverage areas 112 may be associated with different network entities 102. Information and signals described herein may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

[0064] The one or more UEs 104 may be dispersed throughout a geographic region of the wireless communications system 100. A UE 104 may include or may be referred to as a mobile device, a wireless device, a remote device, a remote unit, a handheld device, or a subscriber device, or some other suitable terminology. In some implementations, the UE 104 may be referred to as a unit, a station, a terminal, or a client, among other examples. Additionally, or alternatively, the UE 104 may be referred to as an Internet-of-Things (IoT) device, an Internet-of-Everything (IoE) device, or machine-type communication (MTC) device, among other examples. In some implementations, a UE 104 may be stationary in the wireless communications system 100. In some other implementations, a UE 104 may be mobile in the wireless communications system 100.

[0065] The one or more UEs 104 may be devices in different forms or having different capabilities. Some examples of UEs 104 are illustrated in FIG. 1. A UE 104 may be capable of communicating with various types of devices, such as the network entities 102, other UEs 104, or network equipment (e.g., the core network 106, the packet data network

108, a relay device, an integrated access and backhaul (IAB) node, or another network equipment), as shown in FIG. 1. Additionally, or alternatively, a UE 104 may support communication with other network entities 102 or UEs 104, which may act as relays in the wireless communications system 100.

[0066] A UE 104 may also be able to support wireless communication directly with other UEs 104 over a communication link 114. For example, a UE 104 may support wireless communication directly with another UE 104 over a device-to-device (D2D) communication link. In some implementations, such as vehicle-to-vehicle (V2V) deployments, vehicle-to-everything (V2X) deployments, or cellular-V2X deployments, the communication link 114 may be referred to as a sidelink (SL). For example, a UE 104 may support wireless communication directly with another UE 104 over a PC5 interface.

[0067] A network entity 102 may support communications with the core network 106, or with another network entity 102, or both. For example, a network entity 102 may interface with the core network 106 through one or more backhaul links 116 (e.g., via an S1, N2, N3, or another network interface). The network entities 102 may communicate with each other over the backhaul links 116 (e.g., via an X2, Xn, or another network interface). In some implementations, the network entities 102 may communicate with each other directly (e.g., between the network entities 102). In some other implementations, the network entities 102 may communicate with each other or indirectly (e.g., via the core network 106). In some implementations, one or more network entities 102 may include subcomponents, such as an access network entity, which may be an example of an access node controller (ANC). An ANC may communicate with the one or more UEs 104 through one or more other access network transmission entities, which may be referred to as a radio heads, smart radio heads, or transmission-reception points (TRPs).

[0068] In some implementations, a network entity 102 may be configured in a disaggregated architecture, which may be configured to utilize a protocol stack physically or logically distributed among two or more network entities 102, such as an integrated access backhaul (IAB) network, an open RAN (O-RAN) (e.g., a network configuration sponsored by the O-RAN Alliance), or a virtualized RAN (vRAN) (e.g., a cloud RAN (C-RAN)). For example, a network entity 102 may include one or more of a central unit (CU), a distributed unit (DU), a radio unit (RU), a RAN Intelligent Controller (RIC) (e.g., a Near-Real Time RIC (Near-RT RIC), a Non-Real Time RIC (Non-RT RIC)), a Service Management and Orchestration (SMO) system, or any combination thereof.

[0069] An RU may also be referred to as a radio head, a smart radio head, a remote radio head (RRH), a remote radio unit (RRU), or a transmission reception point (TRP). One or more components of the network entities 102 in a disaggregated RAN architecture may be co-located, or one or more components of the network entities 102 may be located in distributed locations (e.g., separate physical locations). In some implementations, one or more network entities 102 of a disaggregated RAN architecture may be implemented as virtual units (e.g., a virtual CU (VCU), a virtual DU (VDU), a virtual RU (VRU)).

[0070] Split of functionality between a CU, a DU, and an RU may be flexible and may support different functionalities depending upon which functions (e.g., network layer functions, protocol layer functions, baseband functions, radio frequency functions, and any combinations thereof) are performed at a CU, a DU, or an RU. For example, a functional split of a protocol stack may be employed between a CU and a DU such that the CU may support one or more layers of the protocol stack and the DU may support one or more different layers of the protocol stack. In some implementations, the CU may host upper protocol layer (e.g., a layer 3 (L3), a layer 2 (L2)) functionality and signaling (e.g., Radio Resource Control (RRC), service data adaptation protocol (SDAP), Packet Data Convergence Protocol (PDCP)). The CU may be connected to one or more DUs or RUs, and the one or more DUs or RUs may host lower protocol layers, such as a layer 1 (L1) (e.g., physical (PHY) layer) or an L2 (e.g., radio link control (RLC) layer, medium access control (MAC) layer) functionality and signaling, and may each be at least partially controlled by the CU.

[0071] Additionally, or alternatively, a functional split of the protocol stack may be employed between a DU and an RU such that the DU may support one or more layers of the protocol stack and the RU may support one or more different layers of the protocol stack. The DU may support one or multiple different cells (e.g., via one or more RUs). In some implementations, a functional split between a CU and a DU, or between a DU and an RU may be within a protocol layer (e.g., some functions for a protocol layer may be performed by one of a CU, a DU, or an RU, while other functions of the protocol layer are performed by a different one of the CU, the DU, or the RU).

[0072] A CU may be functionally split further into CU control plane (CU-CP) and CU user plane (CU-UP) functions. A CU may be connected to one or more DUs via a midhaul communication link (e.g., F1, F1-C, F1-U), and a DU may be connected to one or more RUs via a fronthaul communication link (e.g., open fronthaul (FH) interface). In some implementations, a midhaul communication link or a fronthaul communication link may be

implemented in accordance with an interface (e.g., a channel) between layers of a protocol stack supported by respective network entities 102 that are in communication via such communication links.

[0073] The core network 106 may support user authentication, access authorization, tracking, connectivity, and other access, routing, or mobility functions. The core network 106 may be an evolved packet core (EPC), or a 5G core (5GC), which may include a control plane entity that manages access and mobility (e.g., a mobility management entity (MME), an access and mobility management functions (AMF)) and a user plane entity that routes packets or interconnects to external networks (e.g., a serving gateway (S-GW), a Packet Data Network (PDN) gateway (P-GW), or a user plane function (UPF)). In some implementations, the control plane entity may manage non-access stratum (NAS) functions, such as mobility, authentication, and bearer management (e.g., data bearers, signal bearers, etc.) for the one or more UEs 104 served by the one or more network entities 102 associated with the core network 106.

[0074] The core network 106 may communicate with the packet data network 108 over one or more backhaul links 116 (e.g., via an S1, N2, N3, or another network interface). The packet data network 108 may include an application server 118. In some implementations, one or more UEs 104 may communicate with the application server 118. A UE 104 may establish a session (e.g., a protocol data unit (PDU) session, or the like) with the core network 106 via a network entity 102. The core network 106 may route traffic (e.g., control information, data, and the like) between the UE 104 and the application server 118 using the established session (e.g., the established PDU session). The PDU session may be an example of a logical connection between the UE 104 and the core network 106 (e.g., one or more network functions of the core network 106).

[0075] In the wireless communications system 100, the network entities 102 and the UEs 104 may use resources of the wireless communications system 100 (e.g., time resources (e.g., symbols, slots, subframes, frames, or the like) or frequency resources (e.g., subcarriers, carriers)) to perform various operations (e.g., wireless communications). In some implementations, the network entities 102 and the UEs 104 may support different resource structures. For example, the network entities 102 and the UEs 104 may support different frame structures. In some implementations, such as in 4G, the network entities 102 and the UEs 104 may support a single frame structure. In some other implementations, such as in 5G and among other suitable radio access technologies, the network entities 102 and the UEs

104 may support various frame structures (i.e., multiple frame structures). The network entities 102 and the UEs 104 may support various frame structures based on one or more numerologies.

[0076] One or more numerologies may be supported in the wireless communications system 100, and a numerology may include a subcarrier spacing and a cyclic prefix. A first numerology (e.g., $\mu=0$) may be associated with a first subcarrier spacing (e.g., 15 kHz) and a normal cyclic prefix. In some implementations, the first numerology (e.g., $\mu=0$) associated with the first subcarrier spacing (e.g., 15 kHz) may utilize one slot per subframe. A second numerology (e.g., $\mu=1$) may be associated with a second subcarrier spacing (e.g., 30 kHz) and a normal cyclic prefix. A third numerology (e.g., $\mu=2$) may be associated with a third subcarrier spacing (e.g., 60 kHz) and a normal cyclic prefix or an extended cyclic prefix. A fourth numerology (e.g., $\mu=3$) may be associated with a fourth subcarrier spacing (e.g., 120 kHz) and a normal cyclic prefix. A fifth numerology (e.g., $\mu=4$) may be associated with a fifth subcarrier spacing (e.g., 240 kHz) and a normal cyclic prefix.

[0077] A time interval of a resource (e.g., a communication resource) may be organized according to frames (also referred to as radio frames). Each frame may have a duration, for example, a 10 millisecond (*ms*) duration. In some implementations, each frame may include multiple subframes. For example, each frame may include 10 subframes, and each subframe may have a duration, for example, a 1 *ms* duration. In some implementations, each frame may have the same duration. In some implementations, each subframe of a frame may have the same duration.

[0078] Additionally or alternatively, a time interval of a resource (e.g., a communication resource) may be organized according to slots. For example, a subframe may include a number (e.g., quantity) of slots. The number of slots in each subframe may also depend on the one or more numerologies supported in the wireless communications system 100. For instance, the first, second, third, fourth, and fifth numerologies (i.e., $\mu=0$, $\mu=1$, $\mu=2$, $\mu=3$, $\mu=4$) associated with respective subcarrier spacings of 15 kHz, 30 kHz, 60 kHz, 120 kHz, and 240 kHz may utilize a single slot per subframe, two slots per subframe, four slots per subframe, eight slots per subframe, and 16 slots per subframe, respectively. Each slot may include a number (e.g., quantity) of symbols (e.g., OFDM symbols). In some implementations, the number (e.g., quantity) of slots for a subframe may depend on a numerology. For a normal cyclic prefix, a slot may include 14 symbols. For an extended cyclic prefix (e.g., applicable for 60 kHz subcarrier spacing), a slot may include 12 symbols. The relationship between

the number of symbols per slot, the number of slots per subframe, and the number of slots per frame for a normal cyclic prefix and an extended cyclic prefix may depend on a numerology. It should be understood that reference to a first numerology (e.g., $\mu=0$) associated with a first subcarrier spacing (e.g., 15 kHz) may be used interchangeably between subframes and slots.

[0079] In the wireless communications system 100, an electromagnetic (EM) spectrum may be split, based on frequency or wavelength, into various classes, frequency bands, frequency channels, etc. By way of example, the wireless communications system 100 may support one or multiple operating frequency bands, such as frequency range designations FR1 (410 MHz – 7.125 GHz), FR2 (24.25 GHz – 52.6 GHz), FR3 (7.125 GHz – 24.25 GHz), FR4 (52.6 GHz – 114.25 GHz), FR4a or FR4-1 (52.6 GHz – 71 GHz), and FR5 (114.25 GHz – 300 GHz). In some implementations, the network entities 102 and the UEs 104 may perform wireless communications over one or more of the operating frequency bands. In some implementations, FR1 may be used by the network entities 102 and the UEs 104, among other equipment or devices for cellular communications traffic (e.g., control information, data). In some implementations, FR2 may be used by the network entities 102 and the UEs 104, among other equipment or devices for short-range, high data rate capabilities.

[0080] FR1 may be associated with one or multiple numerologies (e.g., at least three numerologies). For example, FR1 may be associated with a first numerology (e.g., $\mu=0$), which includes 15 kHz subcarrier spacing; a second numerology (e.g., $\mu=1$), which includes 30 kHz subcarrier spacing; and a third numerology (e.g., $\mu=2$), which includes 60 kHz subcarrier spacing. FR2 may be associated with one or multiple numerologies (e.g., at least 2 numerologies). For example, FR2 may be associated with a third numerology (e.g., $\mu=2$), which includes 60 kHz subcarrier spacing; and a fourth numerology (e.g., $\mu=3$), which includes 120 kHz subcarrier spacing.

[0081] As mentioned, LTM is a cell switch procedure that the network triggers via MAC CE based on L1 measurements. The potential applicable scenarios of LTM include intra-CU intra-DU mobility, intra-CU inter-DU mobility, and inter-CU mobility. Specifically, the UE may move between different cells within a DU in intra-CU intra-DU mobility. The UE may move between different cells belonging to different DUs but within a CU in intra-CU inter-DU mobility. The UE may move between different cells belonging to different DUs, where the DUs belongs to different CUs in inter-CU mobility.

[0082] In some cases, the UE accesses the serving gNB, and the UE reports L3 measurement results based on the configuration from the serving gNB. If the gNB (e.g. CU of gNB) decides to switch the UE to a candidate cell based on the measurement results, the serving gNB requests the target DU(s) to prepare the configuration for one or more than one candidate cell. After receiving the candidate cell configuration from target DU, the serving gNB transmits RRC reconfiguration message including one or more than one candidate cell to UE. For example, CU of the serving gNB transmits the RRC reconfiguration message to UE via source DU.

[0083] The UE transmits RRC reconfiguration complete message to the serving gNB (e.g. CU) via source DU of gNB. UE may ensure UL/DL sync before receiving cell switch command. For example, UE may get TA via random access or preamble transmission. UE reports L1 measurement results for dynamic switching purpose. The serving gNB e.g. source DU transmits cell switch command (e.g. MAC CE or downlink control information (DCI)) to the UE. Then the UE can apply the RRC reconfiguration message and start a timer upon the reception of lower layer command.

[0084] Condition based LTM is proposed for discussion, however, some further details are needed to be studied.

[0085] Embodiments of the present disclosure provide a solution of communication. In the solution, the RAN CU may transmit a first request message to a target RAN CU, where the first request message includes an indication of condition based LTM and an LTM candidate cell. As such, the target RAN CU may know that the UE will perform a condition based LTM, and accordingly a target RAN DU may prepare a configuration for the condition based LTM related to the LTM candidate cell. Therefore, an efficiency of switching of the UE may be guaranteed. Principles and implementations of the present disclosure will be described in detail below with reference to the figures.

[0086] FIG. 2 illustrates a schematic diagram of an example communication network 200 in which some embodiments of the present disclosure can be implemented. As shown in FIG. 2, the communication network 200 may include a RAN CU 210, a RAN CU 220, a RAN DU 230, a RAN DU 241, a RAN DU 242, and a UE 250.

[0087] The RAN CU 210 may be a base station, such as a gNB; or the RAN CU 210 may be considered as a CU of the base station (such as gNB), and the RAN DUs 230 and 241 may be considered as DUs of the base station (such as gNB). The base station may serve

multiple UEs which may include the UE 250 as shown in FIG. 2.

[0088] The RAN CU 220 and the RAN DU 242 may be another base station, for example, the RAN CU 220 is a CU of another base station and the RAN DU 242 is a DU of another base station.

[0089] While considering a mobility of the UE 250, the RAN CU 210 may be considered as a source CU and the RAN DU 230 may be considered as a source DU. The UE 250 may switch to the RAN DU 241, for example, the UE 250 may move to a location 251, in this case, the RAN DU 241 is a target DU, and the mobility is performed within a same CU (a same gNB), it may be called as intra-CU inter DU mobility. The UE may switch to the RAN DU 242, for example, the UE 250 may move to a location 252, in this case, the RAN CU 220 is a target CU and the RAN DU 242 is a target DU, and the mobility is an inter-CU (inter-gNB) mobility.

[0090] It is to be understood that the number of devices in FIG. 2 is given for the purpose of illustration without suggesting any limitations to the present disclosure.

[0091] For ease of description, some related terms are provided below:

[0092] LTM candidate cell: a candidate cell configured to the UE for LTM. There may be multiple LTM candidate cells prepared for the UE, where the LTM candidate cells may belong to the same or different candidate DUs.

[0093] LTM candidate cell configuration: a configuration associated with an LTM candidate cell. An LTM candidate cell configuration can be a complete LTM candidate cell configuration or a delta (difference) configuration with respect to an LTM reference configuration. Each LTM candidate cell configuration is identified by an index, called as LTM candidate cell configuration index, LTM candidate configuration index, or other names. In one example, the LTM candidate cell configuration index is LTM-CandidateId, which is used to identity an LTM candidate cell configuration. For better understanding, the LTM candidate cell configuration is also referred to LTM delta configuration.

[0094] LTM Reference Configuration: A configuration provided by the network to the UE that is common to all the configured LTM candidate cells. It is used by the UE to generate a complete LTM candidate cell configuration (i.e., by applying an LTM candidate cell configuration on top of an LTM reference configuration).

[0095] Complete LTM Candidate Cell Configuration: A configuration that contains all the

necessary fields needed to perform an LTM cell switch procedure. This configuration can be an LTM candidate cell configuration itself or be generated by applying an LTM candidate cell configuration on top of an LTM reference configuration.

[0096] Reference is further made to FIG. 3, which illustrates a signalling chart illustrating communication process 300 for inter-CU condition based LTM in accordance with some example embodiments of the present disclosure. The process 300 may involve the UE 250, the RAN DU (source DU) 230, the RAN CU (source CU) 210, the RAN CU (target CU) 220, and the RAN DU (target DU) 242, as show in FIG. 2. It would be appreciated that the process 300 may be applied to other communication scenarios, which will not be described in detail.

[0097] The process 300 may be regarded as an inter-CU condition based LTM, where the target DU and the source DU belong to different CUs (i.e., different gNBs). The source CU 210 may also be called as a source gNB, and the target CU 220 may also be called as a target gNB.

[0098] In the process 300, the source CU 210 transmits a first request message to the target CU 220 at 310. In some example embodiments, the first request message may indicate condition based LTM and an LTM candidate cell associated with the condition based LTM. In some examples, the LTM candidate cell associated with the condition based LTM may be called as a candidate cell associated with the condition based LTM. In some examples, the LTM candidate cell or the candidate cell may be a target cell.

[0099] In some implementations, the source CU 210 may determine to prepare condition based LTM for the UE 250. In some example embodiments, the source CU 210 may be a MCG gNB or a SCG gNB of the UE 250. In some implementations, the first request message may be a handover request, e.g., over Xn interface.

[00100] In some implementations, the first request message may include an indication of the condition based LTM, in some examples, the condition based LTM may also be referred to as a conditional LTM. In some implementations, the first request message may further include an indication of an LTM candidate cell, for example, the condition based LTM will apply for the LTM candidate cell.

[00101] In some implementations, the first request message may further indicate whether at least one subsequent LTM is supported by condition based LTM. In some examples, the first request message may include information of subsequent LTM(s), for example, the

formation may indicate that the prepared LTM should support (or apply for) subsequent LTM(s).

[00102] In the process 300, the target CU 220 transmits a second request message to the target DU 242 at 320. In some example embodiments, the second request message may indicate condition based LTM and an LTM candidate cell.

[00103] In some implementations, upon receiving the first request message from the source CU 210, the target CU 220 may transmit the second request message to the target DU 242. In some example embodiments, the second request message may be a UE context setup request, e.g., over F1 interface.

[00104] In some implementations, the second request message may include an indication of the condition based LTM. In some implementations, the second request message may further include an indication of an LTM candidate cell, for example, the condition based LTM will apply for the LTM candidate cell.

[00105] In some example embodiments, the indication of condition based LTM may be a type of ENUMERATED, for example, the value of ENUMERATED may indicate one of: condition LTM initiation, condition LTM replace, or condition LTM cancel.

[00106] For example, if the indication of condition based LTM is set to be condition LTM initiation, the target DU 242 which receives the second request message shall consider that the request concerns a conditional LTM for MCG or SCG associated with a candidate cell.

[00107] For example, if the indication of condition based LTM is set to be condition LTM replace, the target DU 242 which receives the second request message shall replace the existing prepared conditional LTM identified by the UE ID (e.g., gNB-DU UE F1 application protocol (F1AP) ID) and the candidate cell ID.

[00108] For example, if the indication of condition based LTM is set to be condition LTM cancel, the target DU 242 which receives the second request message shall consider that the RAN CU 220 is about to remove any reference to, and release any resources previously reserved for the candidate cells associated to the UE.

[00109] In some implementations, the second request message may further indicate an estimated probability for arrival toward the LTM candidate cell related to the condition based LTM. In some example embodiments, an information element (IE) "Estimated Arrival Probability" may be included in the second request message, for example, it may a probability

value for the LTM candidate cell.

[00110] Alternatively, the second request message may further include information indicating whether the estimated probability (the probability value in the “Estimated Arrival Probability” IE) may applied to subsequent LTM(s). For example, the second request message may further include information indicating that the estimated probability is not applied to subsequent LTM, in other words, the estimated probability is only applied for an initial LTM.

[00111] In the process 300, the target DU 242 transmits a second response message to the target CU 220 at 330. In some example embodiments, the second response message is a response to the second request message.

[00112] In some implementations, upon receiving the second request message from the target CU 220, the target DU 242 may determine to accept the request of condition based LTM related to the LTM candidate cell; and the target DU 242 may further respond with the second response message.

[00113] In some implementations, the second response message may include a second configuration associated with the LTM candidate cell. In some examples, the second configuration will be used by the UE 250 to access the LTM candidate cell (i.e. LTM target cell). In some examples, the second configuration may also be called as an RRC configuration for the LTM candidate cell (i.e. LTM target cell).

[00114] In the process 300, the target CU 220 transmits a first response message to the source CU 210 at 340. In some example embodiments, the first response message may include a first configuration for the LTM candidate cell.

[00115] In some implementations, the first configuration may include the second configuration determined by the target DU 242 and a further configuration determined by the target CU 220.

[00116] In the process 300, the source CU 210 transmits the first configuration and one or more corresponding conditions for triggering LTM to the UE 250 at 350. In some examples, a configuration message may be transmitted to the UE 250, e.g., over Uu interface, where the configuration message indicates the first configuration and one or more corresponding conditions.

[00117] In some example embodiments, the one or more corresponding conditions may

include a condition for the LTM candidate cell based on layer 3 (L3) measurements, and/or one more conditions for the LTM candidate cell based on layer 1 (L1) measurements.

[00118] In some examples, the source CU 210 may determine (or generate) the condition for the LTM candidate cell based on L3 measurements, e.g. L3 measurements based condition or L3 condition. For example, the condition for the LTM candidate cell based on L3 measurements may be similar with a condition A3, A4, or A5 for a conditional handover (CHO).

[00119] In some examples, the source CU 210 may transmit (not shown in FIG. 3) a message for requesting the source DU 230 to determine at least one condition for the LTM candidate cell based on L1 measurements. In some examples, the source DU 230 may determine (or generate) the at least one condition for the LTM candidate cell based on L1 measurements, e.g. L1 measurement based condition(s). In some examples, the source DU 230 may transmit, to the source CU 210, the at least one condition for the LTM candidate cell based on L1 measurements. For example, at least one condition for the LTM candidate cell based on L1 measurements may like a condition A4 (A4-like) for a CHO.

[00120] In the process 300, the UE 250 starts a condition evaluation at 360. In some example embodiments, the UE 250 may start evaluating the one or more corresponding conditions after receiving information of the one or more corresponding conditions from the source CU 210.

[00121] In addition or alternatively, the UE 250 may perform an early TA acquisition at 370. In some example embodiments, the UE 250 may get (obtain) an early TA based on a PDCCH order or based on a UE based TA measurement. In some examples, if the UE 250 performs early TA acquisition (gets the early TA) based on the PDCCH order, then the UE 250 may transmit the preamble to the LTM candidate cell. In some examples, after the source DU 230 (or the source CU 210) gets a TA value, the source DU 230 (or the source CU 210) transmits the early TA to the UE 250.

[00122] In the process 300, the UE 250 performs a condition based LTM at 380, e.g., when a condition for the LTM candidate cell is met. In some examples, the UE 250 may switch to the LTM candidate cell (e.g. LTM target cell provided by the target DU 242).

[00123] In some implementations, if a condition based on L3 measurements is met, an RRC layer of the UE 250 may perform the condition based LTM (by applying the first configuration) directly, e.g., once a fulfillment of the L3 measurements based condition is

determined.

[00124] In some implementations, if a condition based on L1 measurements is met, an L1 layer (i.e. PHY layer) of the UE 250 may notify to the RRC layer of a fulfillment of the L1 measurements based condition; and the RRC layer of the UE 250 may perform the condition based LTM (by applying the first configuration) accordingly.

[00125] In addition or alternatively, the UE 250 may further transmit, to the source CU 210 via the source DU 230, information indicating one of: the condition is met, or a selected beam for the LTM candidate cell. In some example embodiments, in case one of the one or more corresponding conditions is met, the information indicating that the condition is met may be transmitted by the UE 250. In some examples, once the condition is met within TTT (timer to trigger) or an entry condition of the LTM execution condition is met), the UE 250 indicates the information to source cell.

[00126] In some examples, there may be multiple candidate cells each meets the condition, in this case, a candidate cell with a valid early TA may be determined as the target cell.

[00127] In some implementations, as mentioned above, the first request message may indicate that at least one subsequent LTM is supported by the condition based LTM. In some examples, if the condition based LTM can support subsequent LTM(s), the UE 250 needs to continue keeping the condition. In some examples, if a condition A4 is used, the UE 250 may continue evaluating a further candidate cell. In some examples, if a condition A3/A5 is used, the UE 250 may continue (or stop) evaluating its source serving cell. In some examples, the condition A3/A5 may be associated with a specific source cell (e.g., cell#0), for example, if the UE 250 is served by the cell#0, the UE 250 starts to evaluate condition A3 related to source cell#0; however, if the UE 250 is served by the cell#1, the UE 250 will not evaluate condition A3 related to source cell#0.

[00128] According to some example embodiments with reference to FIG. 3, when a condition for triggering LTM is met, the condition based LTM may performed by the UE. In some other examples, the UE 250 may receive an LTM cell switching command (e.g., MAC CE) from the source CU 210 or source DU 230, before the operation 380. For example, none of the conditions is met but the MAC CE for switching command is received. In some examples, the UE 250 may perform a cell switching to the candidate cell based on the switching command. In this case, the first configuration may be used while one or more corresponding conditions may be neglected by the UE 250.

[00129] In some examples, a fulfillment of a condition or a reception of the MAC CE may trigger the LTM.

[00130] In some other example embodiments, the candidate cell for the condition based LTM may be cancelled, e.g., before the operation 380. In some examples, the target CU 220 may determine to cancel the candidate cell, for example, the target CU 220 may transmit a first cancel indication to the source CU 210, where the first cancel indication may indicate that the candidate cell has been cancelled, for example, resources reserved for the UE 250 may be released by the target DU 242. For example, the first cancel indication may be a conditional handover cancel, e.g., over Xn interface.

[00131] In some other examples, the source CU 210 may determine to cancel the candidate cell, for example, the source CU 210 may transmit a second cancel indication to the target CU 220, where the second cancel indication may indicate that the candidate cell has been cancelled by the source CU 210. For example, the target CU 220 may forward the second cancel indication to the target DU 242, and the target DU 242 may release the resources reserved for the UE 250.

[00132] In some examples, the source CU 210 may notify the source DU 230 of the cancellation of the candidate cell.

[00133] According to some embodiments discussed with reference to FIG. 3, enhancements for Uu interface, F1 interface, and Xn interface are proposed for condition based LTM. In addition, both L1 condition and L3 condition may be considered for the condition based LTM.

[00134] Reference is further made to FIG. 4, which illustrates a signalling chart illustrating communication process 400 for intra-CU condition based LTM in accordance with some example embodiments of the present disclosure. The process 400 may involve the UE 250, the RAN DU (source DU) 230, the RAN CU 210, and the RAN DU (target DU) 241, as show in FIG. 2. It would be appreciated that the process 400 may be applied to other communication scenarios, which will not be described in detail.

[00135] The process 400 may be regarded as an intra-CU condition based LTM, where the target DU and the source DU belong to the same CU (i.e., the same gNB).

[00136] In the process 400, the RAN CU 210 transmits a second request message to the target DU 241 at 420. In some example embodiments, the second request message may be a UE context setup request, e.g., over F1 interface.

[00137] In some implementations, the RAN CU 210 may determine to prepare condition based LTM for the UE 250. In some implementations, details of the second request message may refer to those discussed with reference to 320 in FIG. 3.

[00138] In the process 400, the target DU 241 transmits a second response message to the RAN CU 210 at 430. In some implementations, the second response message may include a second configuration associated with the LTM candidate cell. In some implementations, details of the second response message may refer to those discussed with reference to 330 in FIG. 3.

[00139] In the process 400, the RAN CN 210 transmits a first configuration and one or more corresponding conditions for triggering LTM to the UE 250 at 450. In some implementations, the first configuration may include the second configuration determined by the target DU 241 and a further configuration determined by the RAN CU 210.

[00140] In some examples, a configuration message may be transmitted to the UE 250, e.g., over Uu interface, where the configuration message indicates the first configuration and one or more corresponding conditions. In some implementations, details of the one or more conditions may refer to those discussed with reference to 350 in FIG. 3.

[00141] In the process 400, the UE 250 starts a condition evaluation at 460. In addition or alternatively, the UE 250 may perform an early TA acquisition at 470. And the UE 250 performs a condition based LTM at 380. In some implementations, details of operations 460-480 may refer to the operations 360-380 respectively discussed above with reference to FIG. 3.

[00142] According to some embodiments discussed with reference to FIG. 4, enhancements for Uu interface and F1 interface are proposed for condition based LTM. In addition, both L1 condition and L3 condition may be considered for the condition based LTM.

[00143] In the current intra-CU LTM, the source DU can share a preamble resource among multiple UEs, for example, the PDCCH order for intra-CU LTM may include information that identifies the allocated contention free random access (CFRA) resource, such as, a synchronization signal (SS) index, a physical broadcast channel (PBCH) index, a random access channel (RACH) occasion, and a random access preamble index. RAN3 assumes that the CFRA resources could be shared only among the UEs in a single gNB-DU, to avoid the RACH access conflict between UEs from different DUs. However, when the LTM is extended to inter-CU LTM, it seems unnecessary to keep the RACH resource in the

granularity of source DU.

[00144] Reference is further made to FIG. 5, which illustrates a signalling chart illustrating communication process 500 for determining RACH resource for early TA acquisition for inter-CU LTM in accordance with some example embodiments of the present disclosure. The process 500 may involve the UE 250, the RAN DU (source DU) 230, the RAN CU (source CU) 210, the RAN CU (target CU) 220, and the RAN DU (target DU) 242, as show in FIG. 2. It would be appreciated that the process 500 may be applied to other communication scenarios, which will not be described in detail.

[00145] The process 500 may be regarded as an inter-CU LTM, where the target DU 242 and the source DU 230 belong to different CUs (i.e., different gNBs).

[00146] In the process 500, the UE 250 transmits a measurement report to the source CU 210 at 510. In some example embodiments, the UE 250 may access the serving gNB which include the source CU 210 and the source DU 230. In some example embodiments, the UE 250 may transmit the measurement report to the serving gNB.

[00147] In some implementations, a dual connectivity (DC) may be configured to the UE 250, for example, both MCG and SCG are configured to the UE 250.

[00148] In the process 500, the source CU 210 transmits a first request message to the target CU 220 at 520. In some implementations, the source CU 210 may determine to prepare LTM configuration for the UE 250, e.g., to initiate the LTM. In some example embodiments, the source CU 210 may be a MCG gNB or a SCG gNB of the UE 250. In some implementations, the first request message may be a handover request, e.g., over Xn interface. In some implementations, the first request message may indicate a candidate cell.

[00149] In some implementations, the first request message may include a request for RACH resource for early TA acquisition. In some example embodiments, the first request message may request RACH resource for the source CU 210, e.g., an index or ID of the source CU 210 may be included. In some other example embodiments, the first request message may request RACH resource for the source DU 230, e.g., an index or ID of the source DU 230 may be included.

[00150] In the process 500, the target CU 220 transmits a second request message to the target DU 242 at 530. In some example embodiments, the second request message may

[00151] In some implementations, upon receiving the first request message from the source

CU 210, the target CU 220 may transmit the second request message to the target DU 242. In some example embodiments, the second request message may be a UE context setup request, e.g., over F1 interface.

[00152] In some implementations, the second request message may indicate a candidate cell.

[00153] In some implementations, the second request message may include a request for RACH resource for early TA acquisition. In some example embodiments, the second request message may include an index or ID of the source CU 210, and the second request message may request RACH resource for the source CU 210. In some other example embodiments, if the first request message includes an index or ID of the source DU 230, then the second request message may include an index or ID of the source DU 230, and the second request message may request RACH resource for the source DU 230.

[00154] For example, the second request message may include a request indication for RACH resource for early TA acquisition and a corresponding index/ID of source CU 210 or source DU 230.

[00155] In the process 500, the target DU 242 transmits a second response message to the target CU 220 at 540. In some example embodiments, the second response message may include a second configuration associated with the candidate cell. In some example embodiments, the second response message may indicate a RACH source for early TA acquisition as requested by the second request message. In some examples, the second configuration may also be called as an RRC configuration for the candidate cell (i.e. LTM target cell).

[00156] In some implementations, upon receiving the second request message from the target CU 220, the target DU 242 may determine to accept the request of LTM related to the candidate cell; and the target DU 242 may further respond with the second response message, e.g., over F1 interface. In some implementations, the second response message may include one of RACH resources for early TA acquisition, an indication that TA value is equal to 0, an indication that TA value of the candidate cell is equal to source cell.

[00157] In some implementations, the target DU 242 may determine the RACH resource per CU (per gNB) or per DU.

[00158] In some example embodiments, in case the second request message includes a request indication for RACH resource for early TA acquisition and corresponding index/ID of the source CU 210, the target DU 242 may determine a RACH resource for early TA

acquisition associated with the source CU 210. For example, the target DU 242 may assign different RACH resource for a different CU (or gNB).

[00159] In some other example embodiments, in case the second request message includes a request indication for RACH resource for early TA acquisition and corresponding index/ID of the source DU 230, the target DU 242 may determine a RACH resource for early TA acquisition associated with the source DU 230.

[00160] In the process 500, the target CU 220 transmits a first response message to the source CU 210 at 550. In some implementations, the first response message may be a handover request acknowledge, e.g., over Xn interface.

[00161] In some implementations, the first response message may include a first configuration, which may include the second configuration determined by the target DU 242 and a further configuration determined by the target CU 220.

[00162] In some implementations, the first response message may include a RACH resource as indicated in the second resource message. In some example embodiments, the first response message may include a RACH resource for early TA acquisition associated with the source CU 210. In some other example embodiments, the first response message may include a RACH resource for early TA acquisition associated with the source DU 230.

[00163] In the process 500, the source CU 210 transmits a configuration to the source DU 230 and the UE 250 respectively at 560.

[00164] In some example embodiments, the first response message may include a RACH resource for early TA acquisition associated with the source CU 210.

[00165] In some examples, the source CU 210 may select some of the RACH resource for early TA acquisition. In some examples, the source CU 210 may transmit a configuration message which includes the some of the RACH resource for early TA acquisition to the source DU 230. For example, there may be more than one DU served by the source CU 210. And the source CU 210 will select the different RACH resource for the different DUs, as such, different UEs served by different DUs will performs early TA acquisition via different RACH resources.

[00166] In some examples, when selecting some of the RACH resource for the target DU 230, a number of UEs performing early TA acquisition may be further considered. For example, with reference to FIG. 2, there are a DU 230 and a DU 241 served by the source

CU 210, the source CU 210 may select a first part of the RACH resource for the DU 230 and a second part of the RACH resource for the DU 241, based on a number of UEs performing early TA acquisition.

[00167] In some other example embodiments, the first response message may include a RACH resource for early TA acquisition associated with the source DU 230.

[00168] In some examples, the source CU 210 may transmit a configuration message which includes the RACH resource for early TA acquisition to the source DU 230.

[00169] In some implementations, the source CU 210 may generate an RRC configuration message and transmits the RRC configuration message to the UE 250. For example, the RRC configuration message may be generated based on the first configuration in the first response message. For example, the RRC configuration message may be transmitted to the UE 250 through the source DU 230. In some examples, the RRC configuration message may include a configuration for LTM associated with the candidate cell. In some examples, the RRC configuration message may include some of the RACH resource for early TA acquisition selected by the source CU 210, or include the RACH resource for early TA acquisition.

[00170] As such, the UE 250 receives the RRC configuration message associated with one or more than one candidate cell(s) for LTM configuration.

[00171] In the process 500, the source DU 230 transmits, to the UE 250, a PDCCH order for triggering TA acquisition related to a particular candidate cell at 570. In some examples, the UE 250 may transmit the preamble for TA acquisition to the candidate cell (target DU 242) upon the reception of PDCCH order, for example, the preamble may be transmitted via the source DU 230, the source CU 210, the target CU 220, to the target DU 242.

[00172] In some examples, if the candidate cell (target DU 242) can calculate TA based on the received preamble, the candidate cell (target DU 242) may transmit the preamble and corresponding RACH occasion, beam indication, UE ID, RA-RNTI, target cell ID, TCI State index for the target cell etc. In some examples, the preamble and corresponding information (RACH occasion, beam indication, UE ID, RA-RNTI, target cell ID, TCI State index for the target cell etc.) may be transmitted from the target DU 242 to the target CU 220, then may be forwarded to the source CU 210 and further to the source DU 230. In some examples, the source DU 230 receives early TA value from source CU 210.

[00173] In the process 500, the source DU 230 transmits an LTM switching command to the

UE 250 at 580. In some implementations, the LTM switching command may be used for triggering cell switching related to a candidate cell. In some implementations, the LTM switching command may be implemented as a MAC CE.

[00174] In addition or alternatively, the source DU 230 may further transmit information associated with a triggered LTM to the source CU 210. In some examples, once the source DU 230 triggers (or decides to trigger) LTM, the source DU 230 needs to indicate the information to source CU 210. In some examples, the information may include at least one of: a cell ID (e.g. an NR cell global identifier (NCGI), a physical cell identifier (PCI)), the selected beam (e.g., a transmission configuration indicator (TCI) state), an indication of RACH-less based LTM or RACH based LTM. Once source CU 210 receives the information from source DU, the source CU 210 will transfer the information to target CU 220 which may further transfer to target DU 242.

[00175] In the process 500, the UE 250 performs the LTM based on the LTM switching command at 590. In some example embodiments, upon reception of the LTM switching command, the UE 250 performs LTM cell switching towards the candidate cell indicated by LTM switching command.

[00176] In some examples, the UE 250 performs LTM cell switching in response to receiving the LTM switching command. In some examples, the target DU 242 may receive information from the target CU 220, and the target DU 242 may transmit a PDCCCH addressed by a cell-radio network temporary identifier (C-RNTI) or monitor the configured CG (configured grant). As such, the UE 250 may successfully access to the target cell of the target DU 242.

[00177] According to some embodiments discussed with reference to FIG. 5, the RACH resource for early TA acquisition may be assigned by the target DU in a granularity of CU or DU, as such, the RACH resource may be used more efficiently and a confliction may be avoided.

[00178] It is to be understood that some further example embodiments may be further obtained by combining some embodiments discussed above, in some examples, the process 300 and the process 500 may be combined, for example, a RACH resource for early TA acquisition may be determined for condition based LTM per DU or per CU.

[00179] FIG. 6 illustrates an example of a device 600 that is suitable for implementing embodiments of the present disclosure. The device 600 may be an example of a RAN node

as described herein. The device 600 may support wireless communication with a RAN CU 210, a RAN CU 220, a RAN DU 230, a RAN DU 241, a RAN DU 242, a UE 250, or any combination thereof. The device 600 may include components for bi-directional communications including components for transmitting and receiving communications, such as a processor 602, a memory 604, a transceiver 606, and, optionally, an I/O controller 608. These components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[00180] The processor 602, the memory 604, the transceiver 606, or various combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described herein. For example, the processor 602, the memory 604, the transceiver 606, or various combinations or components thereof may support a method for performing one or more of the operations described herein.

[00181] In some implementations, the processor 602, the memory 604, the transceiver 606, or various combinations or components thereof may be implemented in hardware (e.g., in communications management circuitry). The hardware may include a processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA) or other programmable logic device, a discrete gate or transistor logic, discrete hardware components, or any combination thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure. In some implementations, the processor 602 and the memory 604 coupled with the processor 602 may be configured to perform one or more of the functions described herein (e.g., executing, by the processor 602, instructions stored in the memory 604).

[00182] For example, the processor 602 may support wireless communication at the device 600 in accordance with examples as disclosed herein. The processor 602 may be configured to operable to support a means for operations discussed above.

[00183] The processor 602 may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a CPU, a microcontroller, an ASIC, an FPGA, a programmable logic device, a discrete gate or transistor logic component, a discrete hardware component, or any combination thereof). In some implementations, the processor 602 may be configured to operate a memory array using a memory controller. In some other implementations, a memory controller may be integrated into the processor 602. The

processor 602 may be configured to execute computer-readable instructions stored in a memory (e.g., the memory 604) to cause the device 600 to perform various functions of the present disclosure.

[00184] The memory 604 may include random access memory (RAM) and read-only memory (ROM). The memory 604 may store computer-readable, computer-executable code including instructions that, when executed by the processor 602 cause the device 600 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. In some implementations, the code may not be directly executable by the processor 602 but may cause a computer (e.g., when compiled and executed) to perform functions described herein. In some implementations, the memory 604 may include, among other things, a basic I/O system (BIOS) which may control basic hardware or software operation such as the interaction with peripheral components or devices.

[00185] The I/O controller 608 may manage input and output signals for the device 600. The I/O controller 608 may also manage peripherals not integrated into the device 600. In some implementations, the I/O controller 608 may represent a physical connection or port to an external peripheral. In some implementations, the I/O controller 608 may utilize an operating system such as iOS®, ANDROID®, MS-WINDOWS®, OS/2®, UNIX®, LINUX®, or another known operating system. In some implementations, the I/O controller 608 may be implemented as part of a processor, such as the processor 602. In some implementations, a user may interact with the device 600 via the I/O controller 608 or via hardware components controlled by the I/O controller 608.

[00186] In some implementations, the device 600 may include a single antenna 610. However, in some other implementations, the device 600 may have more than one antenna 610 (i.e., multiple antennas), including multiple antenna panels or antenna arrays, which may be capable of concurrently transmitting or receiving multiple wireless transmissions. The transceiver 606 may communicate bi-directionally, via the one or more antennas 610, wired, or wireless links as described herein. For example, the transceiver 606 may represent a wireless transceiver and may communicate bi-directionally with another wireless transceiver. The transceiver 606 may also include a modem to modulate the packets, to provide the modulated packets to one or more antennas 610 for transmission, and to demodulate packets received from the one or more antennas 610. The transceiver 606 may include one or more transmit chains, one or more receive chains, or a combination thereof.

[00187] A transmit chain may be configured to generate and transmit signals (e.g., control information, data, packets). The transmit chain may include at least one modulator for modulating data onto a carrier signal, preparing the signal for transmission over a wireless medium. The at least one modulator may be configured to support one or more techniques such as amplitude modulation (AM), frequency modulation (FM), or digital modulation schemes like phase-shift keying (PSK) or quadrature amplitude modulation (QAM). The transmit chain may also include at least one power amplifier configured to amplify the modulated signal to an appropriate power level suitable for transmission over the wireless medium. The transmit chain may also include one or more antennas 610 for transmitting the amplified signal into the air or wireless medium.

[00188] A receive chain may be configured to receive signals (e.g., control information, data, packets) over a wireless medium. For example, the receive chain may include one or more antennas 610 for receive the signal over the air or wireless medium. The receive chain may include at least one amplifier (e.g., a low-noise amplifier (LNA)) configured to amplify the received signal. The receive chain may include at least one demodulator configured to demodulate the receive signal and obtain the transmitted data by reversing the modulation technique applied during transmission of the signal. The receive chain may include at least one decoder for decoding the processing the demodulated signal to receive the transmitted data.

[00189] FIG. 7 illustrates an example of a processor 700 that is suitable for implementing some embodiments of the present disclosure. The processor 700 may be an example of a processor configured to perform various operations in accordance with examples as described herein. The processor 700 may include a controller 702 configured to perform various operations in accordance with examples as described herein. The processor 700 may optionally include at least one memory 704, such as L1/L2/L3 cache. Additionally, or alternatively, the processor 700 may optionally include one or more arithmetic-logic units (ALUs) 706. One or more of these components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[00190] The processor 700 may be a processor chipset and include a protocol stack (e.g., a software stack) executed by the processor chipset to perform various operations (e.g., receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) in accordance with examples as described herein.

The processor chipset may include one or more cores, one or more caches (e.g., memory local to or included in the processor chipset (e.g., the processor 700) or other memory (e.g., random access memory (RAM), read-only memory (ROM), dynamic RAM (DRAM), synchronous dynamic RAM (SDRAM), static RAM (SRAM), ferroelectric RAM (FeRAM), magnetic RAM (MRAM), resistive RAM (RRAM), flash memory, phase change memory (PCM), and others).

[00191] The controller 702 may be configured to manage and coordinate various operations (e.g., signaling, receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) of the processor 700 to cause the processor 700 to support various operations in accordance with examples as described herein. For example, the controller 702 may operate as a control unit of the processor 700, generating control signals that manage the operation of various components of the processor 700. These control signals include enabling or disabling functional units, selecting data paths, initiating memory access, and coordinating timing of operations.

[00192] The controller 702 may be configured to fetch (e.g., obtain, retrieve, receive) instructions from the memory 704 and determine subsequent instruction(s) to be executed to cause the processor 700 to support various operations in accordance with examples as described herein. The controller 702 may be configured to track memory address of instructions associated with the memory 704. The controller 702 may be configured to decode instructions to determine the operation to be performed and the operands involved. For example, the controller 702 may be configured to interpret the instruction and determine control signals to be output to other components of the processor 700 to cause the processor 700 to support various operations in accordance with examples as described herein. Additionally, or alternatively, the controller 702 may be configured to manage flow of data within the processor 700. The controller 702 may be configured to control transfer of data between registers, arithmetic logic units (ALUs), and other functional units of the processor 700.

[00193] The memory 704 may include one or more caches (e.g., memory local to or included in the processor 700 or other memory, such RAM, ROM, DRAM, SDRAM, SRAM, MRAM, flash memory, etc. In some implementations, the memory 704 may reside within or on a processor chipset (e.g., local to the processor 700). In some other implementations, the memory 704 may reside external to the processor chipset (e.g., remote to the processor 700).

[00194] The memory 704 may store computer-readable, computer-executable code including instructions that, when executed by the processor 700, cause the processor 700 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. The controller 702 and/or the processor 700 may be configured to execute computer-readable instructions stored in the memory 704 to cause the processor 700 to perform various functions. For example, the processor 700 and/or the controller 702 may be coupled with or to the memory 704, the processor 700, the controller 702, and the memory 704 may be configured to perform various functions described herein. In some examples, the processor 700 may include multiple processors and the memory 704 may include multiple memories. One or more of the multiple processors may be coupled with one or more of the multiple memories, which may, individually or collectively, be configured to perform various functions herein.

[00195] The one or more ALUs 706 may be configured to support various operations in accordance with examples as described herein. In some implementations, the one or more ALUs 706 may reside within or on a processor chipset (e.g., the processor 700). In some other implementations, the one or more ALUs 706 may reside external to the processor chipset (e.g., the processor 700). One or more ALUs 706 may perform one or more computations such as addition, subtraction, multiplication, and division on data. For example, one or more ALUs 706 may receive input operands and an operation code, which determines an operation to be executed. One or more ALUs 706 be configured with a variety of logical and arithmetic circuits, including adders, subtractors, shifters, and logic gates, to process and manipulate the data according to the operation. Additionally, or alternatively, the one or more ALUs 706 may support logical operations such as AND, OR, exclusive-OR (XOR), not-OR (NOR), and not-AND (NAND), enabling the one or more ALUs 706 to handle conditional operations, comparisons, and bitwise operations.

[00196] The processor 700 may support wireless communication in accordance with examples as disclosed herein. The processor 700 may be configured to or operable to support a means for operations described in some embodiments of the present disclosure.

[00197] FIG. 8 illustrates a flowchart of a method 800 performed by a RAN CU in accordance with aspects of the present disclosure. The operations of the method 800 may be implemented by a device or its components as described herein. For example, the operations of the method 800 may be performed by the RAN CU 210 in FIG. 2. In some implementations, the device may execute a set of instructions to control the function elements

of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[00198] At 810, the method may include transmitting, to a target RAN CU, a first request message indicates condition based LTM and an LTM candidate cell, wherein the condition based LTM will be performed based on an evaluation of conditions by a UE. The operations of 810 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 810 may be performed by the RAN CU 210 as described with reference to FIG. 2.

[00199] At 820, the method may include receiving, from the target RAN CU, a first response message comprising a first configuration for the LTM candidate cell. The operations of 820 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 820 may be performed by the RAN CU 210 as described with reference to FIG. 2.

[00200] FIG. 9 illustrates a flowchart of a method 900 performed by a RAN CU in accordance with aspects of the present disclosure. The operations of the method 900 may be implemented by a device or its components as described herein. For example, the operations of the method 900 may be performed by the RAN CU 210 in FIG. 2. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[00201] At 910, the method may include transmitting, to a target RAN DU, a second request message comprising an indication of condition based LTM and an LTM candidate cell associated with the condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a UE. The operations of 910 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 910 may be performed by the RAN CU 210 as described with reference to FIG. 2.

[00202] At 920, the method may include receiving, from the target RAN DU, a second response message comprising a second configuration for the LTM candidate cell. The operations of 920 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 920 may be performed by the RAN CU 210 as described with reference to FIG. 2.

[00203] FIG. 10 illustrates a flowchart of a method 1000 performed by a target RAN CU in accordance with aspects of the present disclosure. The operations of the method 1000 may be implemented by a device or its components as described herein. For example, the operations of the method 1000 may be performed by the RAN CU 220 in FIG. 2. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[00204] At 1010, the method may include receiving, from a RAN CU, a first request message indicates condition based LTM and an LTM candidate cell associated with the condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a UE. The operations of 1010 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1010 may be performed by the RAN CU 220 as described with reference to FIG. 2.

[00205] At 1020, the method may include transmitting, to a target RAN DU, a second request message indicates the condition based LTM and the LTM candidate cell. The operations of 1020 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1020 may be performed by the RAN CU 220 as described with reference to FIG. 2.

[00206] At 1030, the method may include receiving, from the target RAN DU, a second response message comprising a second configuration associated with the LTM candidate cell. The operations of 1030 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1030 may be performed by the RAN CU 220 as described with reference to FIG. 2.

[00207] At 1040, the method may include transmitting, to the RAN CU, a first response message comprising a first configuration for the LTM candidate cell, wherein the first configuration at least comprises the second configuration. The operations of 1040 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1040 may be performed by the RAN CU 220 as described with reference to FIG. 2.

[00208] FIG. 11 illustrates a flowchart of a method 1100 performed by a target RAN DU in accordance with aspects of the present disclosure. The operations of the method 1100 may be implemented by a device or its components as described herein. For example, the

operations of the method 1100 may be performed by the RAN DU 241 or 242 in FIG. 2. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[00209] At 1110, the method may include receiving, from a RAN CU or a target RAN CU, a second request message indicates condition based LTM and an LTM candidate cell associated with the condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a UE. The operations of 1110 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1110 may be performed by the RAN DU 241 or 242 as described with reference to FIG. 2.

[00210] At 1120, the method may include transmitting, to the RAN CU or the target RAN CU, a second response message comprising second configuration associated with the LTM candidate cell. The operations of 1120 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1120 may be performed by the RAN DU 241 or 242 as described with reference to FIG. 2.

[00211] FIG. 12 illustrates a flowchart of a method 1200 performed by a RAN DU in accordance with aspects of the present disclosure. The operations of the method 1200 may be implemented by a device or its components as described herein. For example, the operations of the method 1200 may be performed by the RAN DU 230 in FIG. 2. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[00212] At 1210, the method may include receiving, from a RAN CU, a message for requesting the RAN DU to determine at least one condition for an LTM candidate cell based on layer 1 measurements, wherein the at least one condition for the LTM candidate cell based on layer 1 measurements is used for condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a UE. The operations of 1210 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1210 may be performed by the RAN DU 230 as described with reference to FIG. 2.

[00213] At 1220, the method may include determining, based on the message, the at least

one condition for the LTM candidate cell based on layer 1 measurements. The operations of 1220 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1220 may be performed by the RAN DU 230 as described with reference to FIG. 2.

[00214] At 1230, the method may include transmitting, to the RAN CU, the at least one condition for the LTM candidate cell based on layer 1 measurements. The operations of 1230 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1230 may be performed by the RAN DU 230 as described with reference to FIG. 2.

[00215] FIG. 13 illustrates a flowchart of a method 1300 performed by a UE in accordance with aspects of the present disclosure. The operations of the method 1300 may be implemented by a device or its components as described herein. For example, the operations of the method 1300 may be performed by the UE 250 in FIG. 2. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[00216] At 1310, the method may include receiving, from a RAN CU, a first configuration for an LTM candidate cell associated with condition based LTM and one or more corresponding conditions for triggering LTM. The operations of 1310 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1310 may be performed by the UE 250 as described with reference to FIG. 2.

[00217] At 1320, the method may include in accordance with a determination that one of the one or more corresponding conditions is met, performing a switching to the LTM candidate cell. The operations of 1320 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1320 may be performed by the UE 250 as described with reference to FIG. 2.

[00218] It should be noted that the methods described herein describes possible implementations, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible. Further, aspects from two or more of the methods may be combined.

[00219] The various illustrative blocks and components described in connection with the disclosure herein may be implemented or performed with a general-purpose processor, a DSP,

an ASIC, a CPU, an FPGA or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor may be a microprocessor, but in the alternative, the processor may be any processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices (e.g., a combination of a DSP and a microprocessor, multiple microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration).

[00220] The functions described herein may be implemented in hardware, software executed by a processor, firmware, or any combination thereof. If implemented in software executed by a processor, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Other examples and implementations are within the scope of the disclosure and appended claims. For example, due to the nature of software, functions described herein may be implemented using software executed by a processor, hardware, firmware, hardwiring, or combinations of any of these. Features implementing functions may also be physically located at various positions, including being distributed such that portions of functions are implemented at different physical locations.

[00221] Computer-readable media includes both non-transitory computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A non-transitory storage medium may be any available medium that may be accessed by a general-purpose or special-purpose computer. By way of example, non-transitory computer-readable media may include RAM, ROM, electrically erasable programmable ROM (EEPROM), flash memory, compact disk (CD) ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other non-transitory medium that may be used to carry or store desired program code means in the form of instructions or data structures and that may be accessed by a general-purpose or special-purpose computer, or a general-purpose or special-purpose processor.

[00222] As used herein, including in the claims, an article “a” before an element is unrestricted and understood to refer to “at least one” of those elements or “one or more” of those elements. The terms “a,” “at least one,” “one or more,” and “at least one of one or more” may be interchangeable. As used herein, including in the claims, “or” as used in a list of items (e.g., a list of items prefaced by a phrase such as “at least one of” or “one or more of” or “one or both of”) indicates an inclusive list such that, for example, a list of at least one of A, B, or C means A or B or C or AB or AC or BC or ABC (i.e., A and B and C).

Also, as used herein, the phrase “based on” shall not be construed as a reference to a closed set of conditions. For example, an example step that is described as “based on condition A” may be based on both a condition A and a condition B without departing from the scope of the present disclosure. In other words, as used herein, the phrase “based on” shall be construed in the same manner as the phrase “based at least in part on. Further, as used herein, including in the claims, a “set” may include one or more elements.

[00223] The description herein is provided to enable a person having ordinary skill in the art to make or use the disclosure. Various modifications to the disclosure will be apparent to a person having ordinary skill in the art, and the generic principles defined herein may be applied to other variations without departing from the scope of the disclosure. Thus, the disclosure is not limited to the examples and designs described herein but is to be accorded the broadest scope consistent with the principles and novel features disclosed herein.

CLAIMS

What is claimed is:

1. A radio access network (RAN) central unit (CU) comprising:
at least one memory; and
at least one processor coupled with the at least one memory and configured to cause the RAN CU to:
transmit, to a target RAN CU, a first request message indicates condition based layer 1 or layer 2 triggered mobility (LTM) and an LTM candidate cell associated with the condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a user equipment (UE); and
receive, from the target RAN CU, a first response message comprising a first configuration for the LTM candidate cell.
2. The RAN CU of claim 1, wherein the first request message further indicates whether at least one subsequent LTM is supported by condition based LTM.
3. The RAN CU of claim 1, wherein the at least one processor is further configured to cause the RAN CU to:
transmit, to the UE, the first configuration for the LTM candidate cell and one or more corresponding conditions for triggering LTM.
4. The RAN CU of claim 3, wherein the at least one processor is further configured to cause the RAN CU to:
generate a condition for the LTM candidate cell based on layer 3 measurements,
wherein the one or more corresponding conditions comprise the condition for the LTM candidate cell based on layer 3 measurements.
5. The RAN CU of claim 3, wherein the at least one processor is further configured to cause the RAN CU to:
transmit, to a RAN distributed unit (DU), a message for requesting the RAN DU to determine at least one condition for the LTM candidate cell based on layer 1 measurements;
and
receive, from the RAN DU, the at least one condition,

wherein the one or more corresponding conditions comprise the at least one condition for the LTM candidate cell based on layer 1 measurements.

6. The RAN CU of claim 3, wherein the at least one processor is further configured to cause the RAN CU to:

receive, from the UE via a RAN DU, information indicating one of: a condition is met, or a selected beam for the LTM candidate cell.

7. The RAN CU of claim 1, wherein the at least one processor is further configured to cause the RAN CU to:

receive, from the target RAN CU, a first cancel indication indicating that the LTM candidate cell configured for the condition based LTM is cancelled.

8. The RAN CU of claim 1, wherein the at least one processor is further configured to cause the RAN CU to:

determine to cancel the LTM candidate cell configured for the condition based LTM;
and

transmit, to the target RAN CU, a second cancel indication indicating that the LTM candidate cell configured for the condition based LTM is cancelled.

9. The RAN CU of claim 1, wherein the first response message further indicates a random access channel (RACH) resource for an early timing advance (TA) acquisition, and wherein the at least one processor is further configured to cause the RAN CU to:

select, for a RAN DU, some of the RACH resource for the early TA acquisition; and
transmit, to the RAN DU, configuration information indicating the some of the RACH resource for the early TA acquisition.

10. The RAN CU of claim 1, wherein the first request message further comprises information of a RAN DU, and the first request message further requests for a RACH resource for an early TA acquisition associated with the RAN DU.

11. A radio access network (RAN) central unit (CU) comprising:

at least one memory; and

at least one processor coupled with the at least one memory and configured to cause

the RAN CU to:

transmit, to a target RAN distributed unit (DU), a second request message comprising an indication of condition based layer 1 or layer 2 triggered mobility (LTM) and an LTM candidate cell associated with the condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a user equipment (UE); and
receive, from the target RAN DU, a second response message comprising a second configuration for the LTM candidate cell.

12. The RAN CU of claim 11, wherein the second request message further indicates whether at least one subsequent LTM is supported by condition based LTM.

13. The RAN CU of claim 11, wherein the second request message further indicates one of:

an estimated probability for arrival toward the LTM candidate cell associated with the condition based LTM, or

whether the estimated probability is applied for at least one subsequent LTM.

14. The RAN CU of claim 11, wherein the at least one processor is further configured to cause the RAN CU to:

transmit, to the UE, a first configuration for the LTM candidate cell and one or more corresponding conditions for triggering LTM, wherein the first configuration at least comprises the second configuration.

15. The RAN CU of claim 14, wherein the at least one processor is further configured to cause the RAN CU to:

generate a condition for the LTM candidate cell based on layer 3 measurements,

wherein the one or more corresponding conditions comprise the condition for the LTM candidate cell based on layer 3 measurements.

16. The RAN CU of claim 14, wherein the at least one processor is further configured to cause the RAN CU to:

transmit, to a RAN distributed unit (DU), a message for requesting the RAN DU to determine at least one condition for the LTM candidate cell based on layer 1 measurements;
and

receive, from the RAN DU, the at least one condition,
wherein the one or more corresponding conditions comprise the at least one condition for the LTM candidate cell based on layer 1 measurements.

17. The RAN CU of claim 14, wherein the at least one processor is further configured to cause the RAN CU to:

receive, from the UE via a RAN DU, information indicating one of: a condition is met, or a selected beam for the LTM candidate cell.

18. The RAN CU of claim 11, wherein the at least one processor is further configured to cause the RAN CU to:

determine to cancel the LTM candidate cell configured for the condition based LTM;
and

transmit, to the target RAN DU, a second cancel indication indicating that the LTM candidate cell configured for the condition based LTM is cancelled.

19. A target radio access network (RAN) central unit (CU) comprising:

at least one memory; and

at least one processor coupled with the at least one memory and configured to cause the target RAN CU to:

receive, from a RAN CU, a first request message indicates condition based layer 1 or layer 2 triggered mobility (LTM) and an LTM candidate cell associated with the condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a user equipment (UE);

transmit, to a target RAN distributed unit (DU), a second request message indicates the condition based LTM and the LTM candidate cell;

receive, from the target RAN DU, a second response message comprising a second configuration associated with the LTM candidate cell; and

transmit, to the RAN CU, a first response message comprising a first configuration for the LTM candidate cell, wherein the first configuration at least comprises the second configuration.

20. A target radio access network (RAN) distributed unit (DU) comprising:

at least one memory; and

at least one processor coupled with the at least one memory and configured to cause the target RAN DU to:

receive, from a RAN central unit (CU) or a target RAN CU, a second request message indicates condition based layer 1 or layer 2 triggered mobility (LTM) and an LTM candidate cell associated with the condition based LTM, wherein the condition based LTM will be performed based on an evaluation of conditions by a user equipment (UE); and

transmit, to the RAN CU or the target RAN CU, a second response message comprising second configuration associated with the LTM candidate cell.