

**ENHANCEMENTS FOR RESOURCE OPTIMIZATION
FOR HANDOVER**

FIELDS

5 [1] Various example embodiments of the present disclosure generally relate to the field of telecommunication and in particular, to methods, devices, apparatuses and computer readable storage medium for enhancements for resource optimization for handover.

BACKGROUND

10 [2] The Layer 1 or Layer 2 (L1/L2) triggered mobility (LTM) mechanism is provided for handover of a terminal device (e.g., UE) from a source cell to a target cell. The LTM procedure is based on a L1 measurement report of the terminal device. The conditional handover (CHO) mechanism is introduced to ensure robustness of the handover procedure. In the CHO procedure, the terminal device is configured
15 with a CHO command containing the target cell configuration and a condition to execute the handover for one or multiple target cells. The condition is based on radio measurements of the neighboring cells.

SUMMARY

[3] In a first aspect of the present disclosure, there is provided a first apparatus.
20 The first apparatus comprises at least one processor; and at least one memory storing instructions that, when executed by the at least one processor, cause the first apparatus at least to perform: receiving, from a source network node for a first apparatus, at least one common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality of candidate target cells in a message without
25 duplicates of information elements (IEs) comprising the at least one common LTM configuration, the first apparatus being configured with a conditional handover and LTM concurrently, and the plurality of candidate target cells being selected by the second apparatus for the conditional handover of the first apparatus; and in accordance with a determination that a target cell is selected from the plurality of
30 candidate target cells for the conditional handover, applying one of the at least one common LTM configuration related to the target cell.

[4] In a second aspect of the present disclosure, there is provided a second apparatus. The second apparatus comprises at least one processor; and at least one memory storing instructions that, when executed by the at least one processor, cause the second apparatus at least to perform: determining at least one common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality of candidate target cells, the terminal device being configured with a conditional handover and LTM concurrently, and the plurality of candidate target cells being selected by the second apparatus for the conditional handover of the terminal device; and transmitting, to a source network node in a source cell of the terminal device, the at least one common LTM configuration in a message without duplicates of information elements (IEs) comprising the at least one common LTM configuration.

[5] In a third aspect of the present disclosure, there is provided a third apparatus. The third apparatus comprises at least one processor; and at least one memory storing instructions that, when executed by the at least one processor, cause the third apparatus at least to perform: receiving, from a target network node for a terminal device, at least one common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality of candidate target cells, the terminal device being configured with a CHO and LTM concurrently, and the plurality of candidate target cells being selected by the second apparatus for the CHO of the terminal device; and transmitting the at least one common LTM configuration to the terminal device in a further message without duplicates of IEs comprising the at least one common LTM configuration.

[6] In a fourth aspect of the present disclosure, there is provided a method. The method comprises: receiving, from a source network node for a first apparatus, at least one common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality of candidate target cells in a message without duplicates of information elements (IEs) comprising the at least one common LTM configuration, the first apparatus being configured with a conditional handover and LTM concurrently, and the plurality of candidate target cells being selected by the second apparatus for the conditional handover of the first apparatus; and in accordance with a determination that a target cell is selected from the plurality of candidate target cells for the conditional handover, applying one of the at least one common LTM configuration related to the target cell.

- [7] In a fifth aspect of the present disclosure, there is provided a method. The method comprises: determining at least one common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality of candidate target cells, the terminal device being configured with a conditional handover and LTM concurrently, and the plurality of candidate target cells being selected by the second apparatus for the conditional handover of the terminal device; and transmitting, to a source network node in a source cell of the terminal device, the at least one common LTM configuration in a message without duplicates of information elements (IEs) comprising the at least one common LTM configuration.
- 10 [8] In a sixth aspect of the present disclosure, there is provided a method. The method comprises: receiving, from a target network node for a terminal device, at least one common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality of candidate target cells, the terminal device being configured with a CHO and LTM concurrently, and the plurality of candidate target cells being
15 selected by the second apparatus for the CHO of the terminal device; and transmitting the at least one common LTM configuration to the terminal device in a further message without duplicates of IEs comprising the at least one common LTM configuration.
- [9] In a seventh aspect of the present disclosure, there is provided a first apparatus.
20 The first apparatus comprises means for receiving, from a source network node for a first apparatus, at least one common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality of candidate target cells in a message without duplicates of information elements (IEs) comprising the at least one common LTM configuration, the first apparatus being configured with a conditional handover and
25 LTM concurrently, and the plurality of candidate target cells being selected by the second apparatus for the conditional handover of the first apparatus; and means for in accordance with a determination that a target cell is selected from the plurality of candidate target cells for the conditional handover, applying one of the at least one common LTM configuration related to the target cell.
- 30 [10] In an eighth aspect of the present disclosure, there is provided a second apparatus. The second apparatus comprises means for determining at least one common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality of candidate target cells, the terminal device being configured with a

conditional handover and LTM concurrently, and the plurality of candidate target cells being selected by the second apparatus for the conditional handover of the terminal device; and means for transmitting, to a source network node in a source cell of the terminal device, the at least one common LTM configuration in a message
5 without duplicates of information elements (IEs) comprising the at least one common LTM configuration.

[11] In a ninth aspect of the present disclosure, there is provided a third apparatus. The third apparatus comprises means for receiving, from a target network node for a terminal device, at least one common layer 1 or layer 2 (L1/L2) triggered mobility
10 (LTM) configuration across a plurality of candidate target cells, the terminal device being configured with a CHO and LTM concurrently, and the plurality of candidate target cells being selected by the second apparatus for the CHO of the terminal device; and means for transmitting the at least one common LTM configuration to the terminal device in a further message without duplicates of IEs comprising the at
15 least one common LTM configuration.

[12] In a tenth aspect of the present disclosure, there is provided a computer readable medium. The computer readable medium comprises instructions stored thereon for causing an apparatus to perform at least the method according to the fourth aspect.

20 [13] In an eleventh aspect of the present disclosure, there is provided a computer readable medium. The computer readable medium comprises instructions stored thereon for causing an apparatus to perform at least the method according to the fifth aspect.

[14] In a twelfth aspect of the present disclosure, there is provided a computer
25 readable medium. The computer readable medium comprises instructions stored thereon for causing an apparatus to perform at least the method according to the sixth aspect.

[15] It is to be understood that the Summary section is not intended to identify key or essential features of embodiments of the present disclosure, nor is it intended to
30 be used to limit the scope of the present disclosure. Other features of the present disclosure will become easily comprehensible through the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[16] Some example embodiments will now be described with reference to the accompanying drawings, where:

[17] FIG. 1 illustrates a signaling flow for an example LTM procedure in a communication system;

5 [18] FIG. 2 illustrates a signaling flow for an example conditional handover (CHO) procedure in a communication system;

[19] FIG. 3 illustrates an example communication environment with a terminal device configured with CHO and LTM;

10 [20] FIG. 4 illustrates a structure of a radio resource control (RRC) reconfiguration message for LTM;

[21] FIG. 5 illustrates an example communication environment with a terminal device configured with more than one candidate target cell for CHO when the terminal device is configured with CHO and LTM concurrently;

15 [22] FIG. 6 illustrates a structure of a RRC message for LTM and CHO with duplicates of target cell configurations;

[23] FIG. 7 illustrates a signaling flow for communication in accordance with some example embodiments of the present disclosure;

[24] FIG. 8 illustrates a structure of a RRC message for LTM and CHO in accordance with some example embodiments of the present disclosure;

20 [25] FIG. 9 illustrates a structure of a RRC message for LTM and CHO in accordance with some further example embodiments of the present disclosure;

[26] FIG. 10 illustrates a structure of a RRC message for LTM and CHO in accordance with some yet further example embodiments of the present disclosure;

25 [27] FIG. 11 illustrates a signaling flow for an example message exchange procedure in accordance with some example embodiments of the present disclosure;

[28] FIG. 12 illustrates a flowchart of a method implemented at a third apparatus in accordance with some example embodiments of the present disclosure;

[29] FIG. 13 illustrates a flowchart of a method implemented at a first apparatus in accordance with some example embodiments of the present disclosure;

[30] FIG. 14 illustrates a flowchart of a method implemented at a second apparatus in accordance with some example embodiments of the present disclosure;

[31] FIG. 15 illustrates a simplified block diagram of a device that is suitable for implementing example embodiments of the present disclosure; and

5 [32] FIG. 16 illustrates a block diagram of an example computer readable medium in accordance with some example embodiments of the present disclosure.

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

DETAILED DESCRIPTION

10 [34] Principle of the present disclosure will now be described with reference to some example 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. Embodiments described herein can be implemented
15 in various manners other than the ones described below.

[35] 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.

[36] References in the present disclosure to “one embodiment,” “an embodiment,”
20 “an example embodiment,” and the like indicate that the embodiment 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 are not necessarily referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in
25 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.

[37] It shall be understood that although the terms “first,” “second,” ..., etc. in front of noun(s) and the like may be used herein to describe various elements, these
30 elements should not be limited by these terms. These terms are only used to distinguish one element from another and they do not limit the order of the noun(s).

For example, a first element could be termed a second element, and similarly, a second element could be termed a first element, without departing from the scope of example embodiments. As used herein, the term “and/or” includes any and all combinations of one or more of the listed terms.

5 [38] As used herein, “at least one of the following: <a list of two or more elements>” and “at least one of <a list of two or more elements>” and similar wording, where the list of two or more elements are joined by “and” or “or”, mean at least any one of the elements, or at least any two or more of the elements, or at least all the elements.

10 [39] As used herein, unless stated explicitly, performing a step “in response to A” does not indicate that the step is performed immediately after “A” occurs and one or more intervening steps may be included.

[40] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of example embodiments. As
15 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, and/or components etc., but do not preclude the presence or addition of
20 one or more other features, elements, components and/ or combinations thereof.

[41] As used in this application, the term “circuitry” may refer to one or more or all of the following:

(a) hardware-only circuit implementations (such as implementations in only analog and/or digital circuitry) and

(b) combinations of hardware circuits and software, such as (as applicable):

(i) a combination of analog and/or digital hardware circuit(s) with software/firmware and

(ii) any portions of hardware processor(s) with software (including digital signal processor(s)), software, and memory(ies) that work together to cause an apparatus, such as a mobile phone or server, to

perform various functions) and

(c) hardware circuit(s) and or processor(s), such as a microprocessor(s) or a portion of a microprocessor(s), that requires software (e.g., firmware) for operation, but the software may not be present when it is not needed for operation.

[42] This definition of circuitry applies to all uses of this term in this application, including in any claims. As a further example, as used in this application, the term circuitry also covers an implementation of merely a hardware circuit or processor (or multiple processors) or portion of a hardware circuit or processor and its (or their) accompanying software and/or firmware. The term circuitry also covers, for example and if applicable to the particular claim element, a baseband integrated circuit or processor integrated circuit for a mobile device or a similar integrated circuit in server, a cellular network device, or other computing or network device.

[43] As used herein, the term “communication network” refers to a network following any suitable communication standards, such as New Radio (NR), Long Term Evolution (LTE), LTE-Advanced (LTE-A), Wideband Code Division Multiple Access (WCDMA), High-Speed Packet Access (HSPA), Narrow Band Internet of Things (NB-IoT) and so on. Furthermore, the communications between a terminal device and a network device in the communication network may be performed according to any suitable generation communication protocols, including, but not limited to, the first generation (1G), the second generation (2G), 2.5G, 2.75G, the third generation (3G), the fourth generation (4G), 4.5G, the fifth generation (5G), the sixth generation (6G) communication protocols, and/or any other protocols either currently known or to be developed in the future. Embodiments of the present disclosure may be applied in various communication systems. Given the rapid development in communications, there will of course also be future type communication technologies and systems with which the present disclosure may be embodied. It should not be seen as limiting the scope of the present disclosure to only the aforementioned system.

[44] As used herein, the term “network device” refers to a node in a communication network via which a terminal device accesses the network and receives services therefrom. The network device may refer to a base station (BS) or an access point (AP), for example, a node B (NodeB or NB), an evolved NodeB (eNodeB or eNB),

an NR NB (also referred to as a gNB), a Remote Radio Unit (RRU), a radio header (RH), a remote radio head (RRH), a relay, an Integrated Access and Backhaul (IAB) node, a low power node such as a femto, a pico, a non-terrestrial network (NTN) or non-ground network device such as a satellite network device, a low earth orbit (LEO) satellite and a geosynchronous earth orbit (GEO) satellite, an aircraft network device, and so forth, depending on the applied terminology and technology. In some example embodiments, radio access network (RAN) split architecture comprises a Centralized Unit (CU) and a Distributed Unit (DU) at an IAB donor node. An IAB node comprises a Mobile Terminal (IAB-MT) part that behaves like a UE toward the parent node, and a DU part of an IAB node behaves like a base station toward the next-hop IAB node.

[45] The term “terminal device” refers to any end device that may be capable of wireless communication. By way of example rather than limitation, a terminal device may also be referred to as a communication device, user equipment (UE), a Subscriber Station (SS), a Portable Subscriber Station, a Mobile Station (MS), or an Access Terminal (AT). The terminal device may include, but not limited to, a mobile phone, a cellular phone, a smart phone, voice over IP (VoIP) phones, wireless local loop phones, a tablet, a wearable terminal device, a personal digital assistant (PDA), portable computers, desktop computer, image capture terminal devices such as digital cameras, gaming terminal devices, music storage and playback appliances, vehicle-mounted wireless terminal devices, wireless endpoints, mobile stations, laptop-embedded equipment (LEE), laptop-mounted equipment (LME), USB dongles, smart devices, wireless customer-premises equipment (CPE), an Internet of Things (IoT) device, a watch or other wearable, a head-mounted display (HMD), a vehicle, a drone, a medical device and applications (e.g., remote surgery), an industrial device and applications (e.g., a robot and/or other wireless devices operating in an industrial and/or an automated processing chain contexts), a consumer electronics device, a device operating on commercial and/or industrial wireless networks, and the like. The terminal device may also correspond to a Mobile Termination (MT) part of an IAB node (e.g., a relay node). In the following description, the terms “terminal device”, “communication device”, “terminal”, “user equipment” and “UE” may be used interchangeably.

[46] As used herein, the term “resource,” “transmission resource,” “resource block,”

“physical resource block” (PRB), “uplink resource,” or “downlink resource” may refer to any resource for performing a communication, for example, a communication between a terminal device and a network device, such as a resource in time domain, a resource in frequency domain, a resource in space domain, a resource in code domain, or any other combination of the time, frequency, space and/or code domain resource enabling a communication, and the like. In the following, unless explicitly stated, a resource in both frequency domain and time domain will be used as an example of a transmission resource for describing some example embodiments of the present disclosure. It is noted that example
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embodiments of the present disclosure are equally applicable to other resources in other domains.

[47] LTM mechanisms are specified for handover which is based on L1 measurement report. In some embodiments, LTM is handling intra-central unit (intra-CU) scenario and the baseline mechanism is shown in FIG. 1. FIG. 1
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illustrates a signaling flow 100 for an example LTM procedure in a communication system with the change of central unit-user plane (CU-UP), e.g., gNB-CU-UP.

[48] A LTM procedure is performed based on L1/L2 measurements of a terminal device. FIG. 1 illustrates a signaling flow 100 for an LTM procedure in a communication system. Without loss of generality, the signaling flow 100 involves
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a terminal device 150 and a network node 152 (e.g., a gNB) which serves the terminal device 150. As shown in FIG. 1, an LTM procedure may split in four phases, including an LTM preparation phase 103, an early synchronization phase 107, an LTM execution phase 111, and an LTM completion phase 116.

[49] During the LTM preparation phase 103, at 101, the terminal device 150 is in
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a radio resource control (RRC) connected (RRC_Connected) state. At 102, the terminal device 150 transmits a measurement report to the network node 152 containing the measurement results for neighboring cells. At 103, the network node 150 (e.g., the serving CU of the network node) performs the LTM candidate preparations by identifying the potential targets based on the measurement report and preparing candidate target cells (or referred to as “target cells” for short). At
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105, the network node 152 shares the LTM candidate configuration (which includes target cell configurations) with the terminal device 150. The LTM candidate configuration may be transmitted in a RRC message as RRC reconfiguration. At 106,

the terminal device 150 may transmit a RRC reconfiguration complete message to the network node 152.

[50] During the early synchronization phase 107, the network node 150 (e.g., the serving DU) asks (considering L1 measurements) the terminal device 150 to perform timing advance (TA) acquisition for a specific target cell. The TA acquisition may include a procedure 108a of downlink (DL) synchronization with candidate cells and a procedure 108b of uplink (UL) synchronization with candidate cells.

[51] During the LTM execution phase 111, at 110, the terminal device 150 transmits a L1 measurement report to the network device 105. At 112, the network node 150 (e.g., the serving DU) makes an LTM decision on a target cell by considering the L1 measurements on the target cell) and requests, at 113, the terminal device 150 to switch to that target cell by transmitting a cell switch command to the terminal device 150. The cell switch command may be transmitted in a medium access control (MAC) control element (CE). At 114, the terminal device 150 detaches from the source cell and applies the target configuration corresponding to the target cell that is received previously. At 115, the terminal device 150 switches to that target cell through a random access channel (RACH) procedure and starts receiving data from the target cell.

[52] During the completion phase 116, the terminal device 150 and the network node 152 perform an LTM completion procedure by releasing the context of the terminal device 150 from the prepared cells. This is optional and the context of the terminal device 150 may be kept in case of dynamic switching. It is up to the CU on how long the context of the terminal device 150 will be maintained.

[53] It is noted that in case the terminal device 150 maintains the configurations of the target cell it is allowed to perform multiple/subsequent LTM operations. This may be referred to as subsequent LTM.

[54] Conditional Handover (CHO) has been introduced to ensure robustness of the handover procedure. In brief, in CHO the serving cell prepares multiple target cells and the related conditional reconfigurations along with CHO execution conditions are provided beforehand to the terminal device, so as to ensure that the radio conditions are still adequate for the terminal device to receive the reconfiguration. Then the terminal device evaluates the CHO execution conditions and initiates the

handover to a specific target cell once its corresponding CHO execution condition is met. CHO is designed so that the terminal device can perform the handover autonomously without the need for the serving cell to trigger the handover (HO) execution e.g., after receiving the measurement report.

5 [55] FIG. 2 illustrates a signaling flow 200 for a CHO procedure in a communication system. Without loss of generality, the signaling flow 200 involves a terminal device 250, a source network node 251, a target network node 252, other potential target node(s) 253, a serving gateway (S-GW)/user plane function (UPF) 254 and a mobility management entity (MME)/access and mobility management
10 function (AMF) 255. It would be appreciated that the source network node 251, the target network node 252, the other potential target node(s) 253 may be radio access network (RAN) nodes, e.g., gNBs or other RAN nodes.

[56] As shown in FIG. 2, at 201, the terminal device 250 transmits a measurement report to a source network node 251, containing the measurement results for
15 neighboring cells. A configured event may trigger the terminal device 250 to send a measurement report. At 202, based on the measurement report from the terminal device 250, the source network node 251 identifies the need to trigger CHO and makes a CHO decision for the terminal device 250. Then the source network node 251 prepares one or more candidate target cells for the handover. The source network
20 node 251 transmits, at 203, 204, CHO requests to the target network node 252 and one or more other potential target network node(s) 253. At 205, the target network node 252 performs admission control and generates the CHO configurations. At 206, the other potential target node(s) 253 performs admission control and generates the CHO configuration. Further, at 207, the target network node 252 transmits the
25 generated CHO configuration to the source network node 251 as a CHO request acknowledge message, and at 208, the other potential target node(s) 253 also transmits the generated CHO configuration to the source network node 251 as a CHO request acknowledge message.

[57] The source network node 251 associates each CHO configuration with a CHO
30 execution condition and then at 209, sends an RRC Reconfiguration message (with a CHO command) to the terminal device 250. At 210, the terminal device 250 evaluates the CHO execution conditions and before any execution condition is fulfilled, the terminal device 250 exchanges user data with the source network node

251. At 211, if a CHO condition is fulfilled for a target cell in the target network node 252, the terminal device 250 stops transmission (TX)/reception (RX) to/from the source network node 251 and accesses the target cell once one of the conditions expires. In such way, the HO preparation phase at 201 to 208 and the execution
5 phase at 210-214 are decoupled.

[58] At 212, the terminal device 250 transmits a physical RACH (PRACH) preamble to the target network node 252 in the target cell and at 213, the target network node 252 transmits a PRACH response to the terminal device 250. Once the terminal device 250 completes the handover execution to the target cell (e.g., the
10 terminal device 250 has sent RRC Reconfiguration Complete message at 214, the target network node 252 in the target cell sends to the source network node 251 a “Handover Success” indication at 215. Then, at 216, the source network node 251 stops transmissions to the terminal device 250 and starts SN status transfer and data forwarding the user plane packets to the target cell in 217 and 218. Moreover, at 219,
15 the source network node 251 may release the CHO preparations in other target nodes/cells (which are no longer needed) when it receives a “HO Success” indication. Further, at 220, the path switch is performed among the source network node 251, the target network node 252, and the S-GW/UPF 254 and the MME/AMF 255 may be involved.

20 [59] In some embodiments, the CHO based on L3 measurements may also be referred to as L3-based CHO, L3 mobility, baseline HO, or conditional LTM.

[60] Even though the LTM mechanism targets intra CU mobility whereas L3 mobility (e.g., the CHO mechanism) can deal with both intra and inter CU mobility, nothing prevents the network node to configure both of them at the same time.
25 Additionally, nothing prevents the target network node to configure LTM at the time of L3 mobility configuration. The network node may configure a terminal device with LTM and CHO simultaneously, concurrently or at the same time. Terminal device may be configured, by the network node, with LTM and CHO concurrently. For example, the terminal device may be configured with CHO and the CHO
30 configuration may include LTM configuration. In another example, the actual configuration might not necessarily happen simultaneously but the UE may be configured with both LTM and CHO concurrently. In some examples, the UE may be configured with CHO and the CHO configuration may include LTM

configurations.

[61] FIG. 3 captures a scenario 300 where a terminal device 332 is configured with LTM in cells 1.1 and 1.2 which belong to DU1 and are controlled by a source CU 310. Based on the measurements of a terminal device 332, the source CU 310 configures L3 mobility (baseline HO or CHO) for a target CU 320 (which controls DU2 (with cells 2.1 and 2.2) and DU3 (with cells 3.1 and 3.2). In this scenario, the target DU 320 has two options. One of the options is to configure L3 mobility for the terminal device 332 to go to cell 2.1 (based on the L3 measurements of the terminal device 332) and then configure (if target DU wishes to do so) LTM for the intra CU cells (i.e., cells 2.1, 2.2, 3.1, and 3.1). The other one of the options is to configure at the same time both L3 mobility and LTM for the terminal device 332, and have in the target cell configuration of the L3 handover command (RRC Configuration) the LTM configuration of these cells belonging to the target CU 320. Following this approach, the terminal device 332 will switch to the target CU 320. Upon being connected to cell 2.1, the terminal device 332 will be able to operate with LTM in cells 2.1, 2.2, 3.1 and 3.2 (including subsequent LTM).

[62] The RRC configuration provided to a terminal device for LTM is captured schematically in FIG. 4. As shown, a structure of the RRC configuration 400 includes a RRC message from a source cell (Source cell RRCReconfig message), which contains a source cell configuration and a target cell configuration. The source cell configuration includes measurements' configuration (in a measConfig IE), radio bearers (in a RadioBearerConfig IE), and a serving cell configuration (in a ServingCellConfig IE). The target cell configuration is comprised in an LTM Configuration information element (IE) (e.g. LTMConfigA IE). The LTM configuration (LTMConfigA) comprises a reference configuration IE 420 (Reference RRC Reconfiguration) which is common for all target cells, an LTM candidate cells IE 430 with a list of delta configurations (one for each target cell) containing the delta (cell-specific) configuration of each candidate target cell (e.g., a delta configuration 450 for a candidate target cell X, a delta configuration 460 for a candidate target cell Y), and an LTM CSI resource configuration IE 440 which contains the target cells beam configuration.

[63] When the terminal device receives the MAC CE to trigger cell change, it applies the target cell delta configuration on top of the reference configuration and

it will create a protocol stack for the LTM candidate cell.

[64] According to the current specifications and agreements, the scenario where a terminal device is configured with both LTM and L3 mobility is supported. However, some further enhancements on the system operation are needed. Otherwise, there
5 may raise some potential issues.

[65] As shown in a scenario 500 of FIG. 5, the terminal device 332 moves from cell 1.1 to cell 2.1. This would be done with L3 mobility to cell 2.1 of the target CU 320.

[66] However, as shown in FIG. 5, it is possible to configure the terminal device 332 with more than one CHO, e.g. with target cells 2.1 and 3.1. In this case,
10 following the standard procedure the terminal device 332 will have two target cell configurations for CHO, one for cell 2.1 and one for cell 3.1. If the target CU 320 decides to provide LTM configuration for cells 2.1, 2.2, 3.1 and 3.2, the RRC configuration will contain two times the same configuration (marked as LTMConfigB) for the LTM cells, one for the target cell 2.1 and one for the target
15 cell 3.1, as shown in FIG. 6.

[67] FIG. 6 illustrates a structure 600 of a RRC message for LTM and CHO with duplicates of target cell configurations (LTMConfigB) for the terminal device 332. As can be seen, the target cell configurations 620 and 630 for L3 mobility (in the conditionalReconfiguration IE) of the source cell RRC reconfiguration message 610
20 contain a duplicate of information (LTMConfigB), which is identical reference configuration for all cells as well as candidate target cell configurations (for cells 2.1, 2.2, 3.1, 3.2). Each of the LTMConfigB IEs 622, 632 contains in the target cell configurations 620 and 630 all the IEs as shown in FIG. 4. Note that in the example of FIG. 6 the terminal device 332 also has LTM configuration for cells 1.1 and 1.2
25 marked as the LTMConfigA IE 614. This results to a large sized RRC message to be sent to the terminal device, which is mainly or at least partly caused by information repetition.

[68] Example embodiments of the present disclosure propose enhancements in the configuration message structure, in order to reduce the duplications of information
30 elements when a terminal device is configured at the same time with LTM and CHO (L3 mobility). According to the example embodiments of the present disclosure, a target network node prepares at least one common LTM configuration across a

plurality of candidate target cells for a terminal device. A common LTM configuration may comprise configuration information for two or more candidate target cells. Alternatively, the common LTM configuration can comprise configuration information for at least one candidate target cell. For example, the
5 common LTM configuration may comprise configuration information for a single candidate target cell, in a case where the terminal device is configured with CHO for a plurality of cells bordering with the single candidate target cell. (Bordering here is a radio term, not a physical term, meaning that the cells bordering each other are not necessarily physically next to each other.) The at least one LTM
10 configuration is transmitted in a message without duplicates of information elements (IEs) comprising the at least one LTM configuration to a source network node and/or to the terminal device.

[69] In this way, the configuration redundancy in message exchange for simultaneous CHO and LTM. In some example embodiments, this enables a shorter
15 RRC reconfiguration message leading to a shorter transmission time, a reduced signal overhead, a reduced mobility latency, a smaller memory requirement to store the RRC reconfiguration message.

[70] FIG. 7 illustrates a signaling flow for communication in accordance with some example embodiments of the present disclosure. Without loss of generality, the
20 signaling flow 700 involves a first apparatus 751, a second apparatus 752, and a third apparatus 753.

[71] In some example embodiments, the first apparatus 751 may be or may be comprised in a terminal device, e.g., a UE. In some example embodiments, the third
25 apparatus 753 may be or may be comprised in a source network node (e.g., a gNB) in a serving or source cell of the terminal device or the first apparatus 751. In some example embodiments, the source network node may comprise a CU (referred to as a source CU) and one or more DUs (referred to as source DUs). A DU may be configured to serve one or more cells under a CU. The third apparatus 753 may be or may be comprised in the source CU.

30 [72] In some example embodiments, the second apparatus 752 may be or may be in a target network node (e.g., a gNB) in a target cell of the terminal device or the first apparatus 751. In some example embodiments, the target network node may comprise a CU (referred to as a target CU) and one or more DUs (referred to as

target DUs). The second apparatus 752 may be or may be comprised in the target CU.

[73] In the signaling flow 700, it is assumed that the first apparatus 751 is in a connected status with the third apparatus 753. The first apparatus 751 (or the corresponding terminal device) is configured with LTM and CHO concurrently. In some example embodiments, the LTM may be based on L1/L3 measurements, and CHO is based on L3 measurements. In some example embodiments, the CHO based on L3 measurements may also be referred to as L3-based CHO, L3 mobility, baseline HO, or conditional LTM.

[74] At 708, the second apparatus 752 determines at least one common LTM configuration across a plurality of candidate target cells. The plurality of candidate target cells are selected by the second apparatus 752 for the conditional handover of the first apparatus 751. In some example embodiments, the plurality of candidate target cells are controlled by the second apparatus 752 (e.g., by a CU of a network node).

[75] To avoid configuration information redundancy for the plurality of candidate target cells, the second apparatus 752 may determine whether two or more of the plurality of candidate target cells share an LTM configuration. If the second apparatus 752 identifies two or more candidate target cells that shares a LTC configuration, the second apparatus 752 determine a common LTM configuration corresponding to the shared LTM configuration of the two or more candidate target cells. In this case, a common LTM configuration thus comprises configuration information for the two or more candidate target cells.

[76] In some example embodiments, among the plurality of candidate target cells, there may be a candidate target cell that share no configuration information with other candidate target cell. In this case, among the at least one common LTM configuration, there may be a common LTM configuration corresponding to this candidate target cell, which comprises configuration information for this candidate target cell.

[77] By introducing the common LTM configuration, the configuration information redundancy is avoided in the case where a plurality of candidate target cells share the LTM configuration.

[78] Conventionally, if a terminal device is configured with simultaneous CHO and LTM, according to the current standards, LTM configuration of the target cell is signaled/sent as part of the target cell delta RRC reconfiguration IE within conditional reconfiguration IE of the source cell's RRC reconfiguration message. In this case, if the target CU is associated with multiple DUs, target cell LTM configuration is repeated within the Source cell RRC reconfiguration message resulting in a large sized RRC reconfiguration message due to the repeated, i.e., redundant configuration information or duplicates of configuration information.

[79] Example embodiments of the present disclosure provide a new signaling and new terminal device and network device behaviors to reduce redundancy in a RRC (re)configuration message in case of simultaneous configuration of L3-based conditional handover (CHO) and L1/2 triggered mobility (LTM).

[80] In some example embodiments, one new IE in a message is introduced, which includes at least one common LTM configuration when configuring the terminal device with concurrent conditional handover and LTM. In some example embodiments, a common LTM configuration of the at least one common LTM configuration is comprised in an IE of a RRC message. In some example embodiments, the common LTM configuration may be comprised in a single IE of the RRC message. In some example embodiments, if two or more common LTM configurations are determined, a common LTM configuration for a plurality of target cells may be comprised in a single IE, and another common LTM configuration for another plurality of target cells may be comprised in another single IE, and so on.

[81] At 710, the second apparatus 752 transmits, to a source network node in a source cell of the terminal device, the at least one common LTM configuration in the message without duplicates of IEs. In some example embodiments, the second apparatus 752 may transmit the at least one common LTM configuration in the message without duplicates of IEs to the first apparatus 751.

[82] At 712, the third apparatus 753 receives the at least one common LTM configuration and at 714, transmits the at least one common LTM configuration to the first apparatus 751 without duplicates of IEs, e.g. in a further message .

[83] At 716, the first apparatus 751 receives the at least one common LTM configuration without duplicates of IEs. In some example embodiments, the

exchange of the at least one common LTM configuration may be carried in a preparation phase for CHO and LTM.

[84] In some example embodiments, the message transmitted from the second apparatus 752 to the third apparatus 753, and/or from the third apparatus 753 to the first apparatus 751 may comprise RRC messages. In those example embodiments, the RRC message or more specifically, the RRC reconfiguration message is restructured in case of simultaneous (L3-based) CHO and LTM. As such, it is proposed to send the LTM configuration IE for a candidate target cell outside of the delta RRC reconfiguration IE of the target cell. It is proposed to remove the LTM configuration IE for a candidate target cell from the target cell delta RRC reconfiguration IE of the target cell. In some example embodiments, the LTM configuration IE is proposed to be sent according to one of the three solution options mentioned below.

[85] The first apparatus 751 receives one or more LTM configuration IE within the RRC message, where the at least one common LTM configuration in the IE applies to two or more candidate target cells. The first apparatus 751 may evaluate CHO conditions. If a CHO condition is fulfilled, the first apparatus 751 may select a target cell from the plurality of candidate target cells for the CHO. In this case, at 718, the first apparatus 751 applies one of the at least one received common LTM configuration related to the target cell.

[86] In some example embodiments, the exchange of the at least one common LTM configuration is triggered based on measurements reported by the first apparatus 751. As shown in FIG. 7, at 702, the first apparatus 751 may transmit a measurement report to the third apparatus 753. The measurement report may comprise a L3 measurement report. At 704, the third apparatus 753 makes a CHO decision based on the L3 measurement report, which may include inter CU handover. At 706, the third apparatus 753 transmits a CHO request to the second apparatus 752. Upon reception of the CHO request, at 708, the second apparatus 752 may select a plurality of candidate target cells for CHO of the first apparatus 751.

[87] In some example embodiments, the network node can configure the first apparatus 751 to not apply CHO configuration even if a CHO condition is fulfilled in case the same cell is configured for both CHO and LTM. In other words, LTM is or may be preferred over CHO. For example, in the scenario 500 of FIG. 5, if the

terminal device 332 moves to Cell 2.1 and Cell 3.1 is configured with both LTM and CHO, the terminal device 332 prefers LTM and will not apply the CHO procedure (e.g., CHO condition check and/or CHO configuration application).

5 [88] In some example embodiments, the second apparatus 752 may prepare and transmit a common LTM configuration across the plurality of candidate target cells as a part of a conditional reconfiguration for the first apparatus 751.

[89] In some example embodiments, the common LTM configuration is comprised in a first IE for the conditional reconfiguration in a RRC message (further, in the source cell RRC reconfiguration message transmitted by the third apparatus 753). In
10 some example embodiments, the second apparatus 752 may introduce or place the new IE for the common LTM configuration within the conditional reconfiguration IE (further within the source cell RRC reconfiguration message). The first apparatus 751 may read or decode the IE for the common LTM configuration within the conditional reconfiguration IE (further within the source cell RRC reconfiguration
15 message).

[90] In some example embodiments, the RRC message (e.g., the source cell RRC reconfiguration message) may comprise a plurality of IEs for delta RRC reconfigurations corresponding to the plurality of candidate target cells, the first IE and the plurality of IEs being at a same level in an information structure in the RRC
20 message. An RRC message may be considered to have a layered structure. For example, FIG. 8 shows RRC message with two levels or layers, wherein IEs 812 and 814 are on a high level or layer and IEs 820, 830, 340, 850, 860, 870 are on another level or layer which is a lower level or layer than the high level or layer.

[91] In some example embodiments, a separate reference configuration IE is used
25 for the CHO (e.g., in case of PCell change). In some example embodiments, CHO configuration is provided using a separate reference configuration IE. This means that for multiple CHO cells, if there is a common LTM configuration, this will be included in the conditional reconfiguration IE and it will be common thus avoiding duplications.

30 [92] In this solution, the RRC configuration may be restructured as shown in a structure 800 of FIG. 8. As shown in FIG. 8, a common LTM configuration for candidate target cells is conveyed in an LTMConfigB IE 840, with common

configuration information for a plurality of candidate target cells. The LTMConfigB IE 840 is included in a conditional reconfiguration (conditionalReconfiguration) IE 812 which is further included in a source cell RRC reconfiguration message (source cell RRCReconfig message) 810. The source cell RRCReconfig message 810 may be further included in a higher level or layer of RRC message.

[93] The conditionalReconfiguration 812 may be included at a same level or layer of a further LTM configuration (LTMConfigA) IE 814. The LTMConfigA IE 814 contains a reference RRC configuration IE 850 which is common for all target cells, an LTM candidate cells IE 860 with a list of delta configurations (one for each target cell) containing the delta (cell-specific) configuration of each candidate target cell, and an LTM CSI resource configuration IE 870 which contains the target cells beam configuration. The LTMConfigA IE 814 may be the same or similar as the LTMConfigA IE in FIGS. 4 and 6.

[94] In addition to the LTMConfigB IE 840, the conditionalReconfiguration IE 812 further comprises a plurality of IEs for delta RRC reconfigurations, e.g., a delta RRC reconfiguration IE 820 for a first target cell (e.g., Cell 2.1 in the example scenario 500 of FIG. 5) and a delta RRC reconfiguration IE 830 for a second target cell (e.g., Cell 3.1 in the example scenario 500 of FIG. 5).

[95] When referring to the example scenario 500 in FIG. 5, the LTM configuration of Cells 2.1, 2.2, 3.1, and 3.2 will be contained inside the conditionalReconfiguration IE 812 (containing the CHO configurations) but outside the configuration for each target cell. In order to obtain the target cell configuration, the terminal device, once the condition for going in that cell is fulfilled, will apply the target LTM configuration (in LTMConfigB IE 840) on top of the target cell configuration, e.g., Target Cell 2.1 configuration, and it will apply it in the protocol stack.

[96] Structure of FIG. 8 is beneficial due to its simple implementation using a current RRC structure as a basis. A single LTM configuration for the candidate target cells is configurable in the RRC message. LTMConfigB is comprised in the RRC message 810 without duplicates.

[97] In some example embodiments, CHO conditions are used for LTM configuration application. CHO conditions for the target cells are provided separately. The configurations for the candidate target cells are LTM configurations.

In case a CHO condition is fulfilled, the terminal device will apply the LTM configuration linked with the CHO condition. In some example embodiments, the second apparatus 752 transmits the at least one common LTM configuration across the plurality of candidate target cells and a first indication indicating at least one
5 condition for applying the at least one common LTM configuration, respectively. In those example embodiments, the second apparatus 752 introduces a conditional reconfiguration condition indication (i.e., the first indication) indicating a common LTM configuration (or an L3-based conditional handover), and sends the indication to the third apparatus 753 or the first apparatus 751.

10 [98] In some example embodiments, the first indication indicates at least one condition to be evaluated by the first apparatus 751 for the CHO.

[99] The third apparatus 753 receiving the conditional reconfiguration condition indication indicating a common LTM configuration (or an L3-based conditional handover), placing the common LTM configuration within source cell RRC
15 reconfiguration message (in parallel to source cell LTM configuration). The first apparatus 751 may read or decode a conditional reconfiguration condition indication, read or decode an LTM configuration (or a L3-based conditional reconfiguration) at least based on the received conditional reconfiguration condition indication.

[100] In some example embodiments, the at least one common LTM configuration
20 may be comprised in a first IE and the first indication may be comprised in a second IE in a RRC message, where the first IE and the second IE are at a same level or layer in an information structure of in the RRC message.

[101] In some example embodiments, the at least one common LTM configuration may two or more common LTM configurations, one for a plurality of target cells,
25 and another common LTM configuration for another plurality of target cells. In some example embodiments, if two or more common LTM configurations are determined, a common LTM configuration for a plurality of target cells may be comprised in a single IE, and another common LTM configuration for another plurality of target cells may be comprised in another single IE, and so on.

30 [102] In some example embodiments, the RRC configuration may be restructured as shown in a structure 900 in FIG. 9. As shown in FIG. 9, a common LTM configuration for candidate target cells is conveyed in an LTMConfigB IE 912 which

is in a same level of the LTMConfigA IE 914 in a source cell RRCReconfig message 910. The LTMConfigA IE 914 may be the same or similar as the LTMConfigA IE 814 or the LTMConfigA IE in FIGS. 4 and 6.

[103] The LTMConfigB IE 912, which comprises common configuration information for candidate target cells, is in a similar format as the LTMConfigA IE 914. As shown, the LTMConfigB IE 912 contains a reference RRC configuration IE 920 which is common for all target cells, an LTM candidate cells IE 930 with a list of delta configurations (one for each target cell) containing the delta (cell-specific) configuration of each candidate target cell, and an LTM CSI resource configuration IE 940 which contains the target cells beam configuration.

[104] Further, the source cell RRCReconfig message includes a conditionalReconfigurationCond IE 916 which contains at least one condition for applying the at least one common LTM configuration in the LTMConfigB IE 912.

[105] When referring to the example scenario 500 in FIG. 5, the LTM configuration of Cells 2.1, 2.2, 3.1, and 3.2 will be in the source cell configuration (e.g., in the LTMConfigB IE 912) but independent from the current accessible LTM cells (e.g., in the LTMConfigA IE 914). The source cell configuration in the message 910 will contain the conditionalReconfigCond IE 916 which contains the conditions that the terminal device evaluates to perform conditional handover, but it will not contain the conditionalReconfiguration IE 916 which contains the target cell configurations. Each condition of the conditionalReconfigCond IE 916 will point to a target cell configuration of the LTMConfigB IE 912 (in this case cells 2.1 and 3.1). Once the condition is fulfilled the terminal device will apply in its protocol stack the LTM target cell configuration.

[106] Structure of FIG. 9 is beneficial due to its simple implementation using a current RRC structure as a basis, and requiring only a mapping between conditions and target cell configurations. As the LTM is mixed with conditional reconfiguration, if the terminal device is configured with both LTM and L3 mobility simultaneously, it may need to carefully deal with the conditional judgment. LTMConfigB is comprised in the RRC message 910 without duplicates.

[107] In some example embodiment, the second apparatus 752 may transmit, to the third apparatus 753, the at least one common LTM configuration across the plurality

of candidate target cells. Further, the second apparatus 752 may transmit, to the third apparatus 753, a plurality of delta RRC reconfigurations corresponding to the plurality of candidate target cells, a delta RRC reconfiguration among the plurality of delta RRC reconfigurations comprising a second indication indicating one of the
5 at least one common LTM configuration. In some example embodiments, two or more second indications in two or more of the plurality of delta RRC reconfigurations point to a same one of the at least one common LTM configuration.

[108] In some example embodiments, the second apparatus 752 may introduce a target cell LTM configuration indication (i.e., the second indication) within the
10 target cell delta RRC configuration message, the target cell LTM configuration indication pointing to one or more target cell LTM configuration. Two or more of the multiple target cell delta RRC configuration messages possibly share the same target cell LTM configuration indication pointing to the same target cell LTM configuration. Two or more of the multiple target cell delta RRC configuration
15 messages possibly include different target cell LTM configuration pointing to different target cell LTM configurations. The second apparatus 752 may send the target cell delta RRC reconfiguration IE (possibly within a conditional reconfiguration IE) including target cell LTM configuration indication to the third apparatus 753 and/or the first apparatus 751. In some example embodiments, the
20 first apparatus 751 may read or decode the target cell LTM configuration indication possibly within the target cell delta RRC configuration message (further possibly within conditional reconfiguration IE, and further within the source cell RRC reconfiguration message). The first apparatus 751 may read or decode one or more target cell LTM configuration at least based on the target cell LTM configuration
25 indication.

[109] In some example embodiments, the plurality of delta RRC reconfigurations corresponding to the plurality of candidate target cells and the at least one common LTM configuration are comprised in a level or layer of a RRC message, and the at least one common LTM configuration may be comprised in another level or layer of
30 the RRC message than the plurality of delta RRC reconfigurations. In some example embodiments, one more layer in the target cell RRC configuration message may be added to contain the at least one common LTM configuration.

[110] In some example embodiments, common reference configuration among the

target cell configurations is used. Each CHO configuration has specific fields for each target cell. The target cell configurations share the same reference configuration, since this is prepared by the same Target CU.

[111] In this solution, the RRC configuration may be restructured as shown in a structure 1000 of FIG. 10. As shown in FIG. 10, a common LTM configuration for candidate target cells is conveyed in an LTMConfigB IE 1070, which may be included in another level of RRC message than the source cell RRCReconfig message 1010. The LTMConfigB IE 1070, which comprises common configuration information for candidate target cells, is in a similar format as the LTMConfigB IE 912 in FIG. 9.

[112] Further, delta RRC reconfiguration IEs 1020 and 1030 corresponding to the plurality of candidate target cells are prepared and included in a conditionalReconfiguraiton IE 1012. Each of the delta RRC reconfiguration IEs 1020, 1030 contains a second indication, i.e., LTMConfigRef 1022, 1024, which points to the LTMConfigB IE 1017 because the corresponding target cells share the common LTM configuration in the LTMConfigB IE 1017. The conditionalReconfiguraiton IE 1012 is in a same level of the LTMConfigA IE 1014 in a source cell RRCReconfig message 1010.

[113] When referring to the example scenario 500 in FIG. 5, each delta RRC configuration of Cells 2.1, 2.2, 3.1, and 3.2 contains a second indication (e.g., LTMConfigRef 1022, 1024) to an IE which will contain the LTM target cell configurations (i.e., LTMConfigB IE 1070). In order to obtain the target cell configuration, the terminal device, once the condition for going in that cell is fulfilled it will decode the LTMConfigB IE that the LTMConfigRef points to and it will apply it on top of the target cell configuration. Then it will apply it in the protocol stack.

[114] This message structure of FIG. 10 can extend the current RRC message structure, and may enable introduction of multiple LTMConfigRef IEs as possible target cells in a way that it reduces the redundancy in the RRC message. For example, the RRC message may comprise three levels or layers. LTMConfigB is comprised in the RRC message 1010 without duplicates.

[115] In order to better understand the example embodiments, reference will be

made to an example signaling flow involving more specific communication devices in an example communication environment. FIG. 11 illustrates a signaling flow 1100 for an example message exchange procedure in accordance with some example embodiments of the present disclosure. Without loss of generality, the signaling flow 5 1100 involves a terminal device 1170 (which may be corresponding to the first apparatus 751 in FIG. 7), a DU 1171 and a source CU 1172 of a source network node 1176 for the terminal device 1170, and a target CU 1173 1173 and two DUs 1174, 1175 of a target network node 1178 for the terminal device 1170. It would be appreciated that although one or two DUs in a network node are shown, a network 10 node may include any suitable number of DUs.

[116] The signaling flow 1100 shows the delivery of the updated messages to the terminal device 1170. Operations from 1111 to 1120 are similar as those performed for the CHO and LTM scenario. In the signaling flow 1100, for better understanding, reference is made to the example scenario 500 of FIG. 5 as an example. It is assumed 15 that the terminal device 1170 is in Cell 1.1 which is corresponding to the DU 1171 of the source CU 1172. According to the measurement reports from the terminal device 1170, at 1114, the source CU 1172 makes an inter-CU L3 mobility (CHO) decision for two target cells, e.g., Cell 2.1 and Cell 3.1 in the scenario 500 in FIG. 5. At 1116, the target CU controlling Cell 2.1 and Cell 3.1 may determine a CHO 20 for Cell 2.1 of DU 1174, a CHO for Cell 3.1 of DU 1175, and LTM mobility decision for cells 1.1, 1.2, 2.1, 2.2 from DUs 1174, 1175.

[117] After the UE context setup procedures are completed with the DUs 1174, 1175, the target CU 1173 prepares RRC configuration at 1121. As compared to conventional operations, at 1121, the target CU 1173 will prepare the target cell 25 configurations and provide them according to any of the message structures as discussed in the above example embodiments, such as the message structure 800, 900, or 1000.

[118] In the example embodiment related to the message structures 900 and 1000, the configurations of the candidate target cells are prepared by the target CU 1173, 30 whereas in the message structure 800, the target CU 1173 provides two IEs one for the target cell CHO configurations and one separate IE with the LTM configurations.

[119] At 1123 to 1125, the source CU 1172 compiles the RRC message (a RRC reconfiguration message) based on the response from the target CU 1173, and sends

it to the terminal device 1170. At 1126, the terminal device 1170 transmits a RRC reconfiguration complete message to the DU 1171, and at 1127, the DU 1171 performs an UL RRC message transfer to the source CU 1172.

5 [120] At 1128, the terminal device 1170 may trigger a CU LTM with the DU 1171 and the source CU 1172.

[121] At 1129, if a CHO condition is triggered, a CHO from a source cell (e.g., Cell 1.1 in the scenario 500 of FIG. 5) to a target cell (e.g., Cell 2.1 in the scenario 500 of FIG. 5), the terminal device 1170 prepares the target cell configuration as indicated in the message structure 800, 900, or 1000.

10 [122] At 1130, the terminal device 1170 initiates a RACH procedure to the DU 1174 which is responsible for the selected target cell (e.g., Cell 2.1). At 1131, the DU 1174 transmits an access notification to the target CU 1173. At 1130, the terminal device 1170 transmits a RRCH reconfiguration complete message to the DU 1174 and at 1133 the DU 1174 also transmits a RRCH reconfiguration complete message
15 to the target CU 1174.

[123] After the inter CU handover of the terminal device 1170 from the source CU 1171 to the target CU 1173 is completed, at 1135, the terminal device 1170 may further perform LTM in cells controlled by the target CU 1173.

20 [124] FIG. 12 shows a flowchart of an example method 1200 implemented at a first device in accordance with some example embodiments of the present disclosure. For the purpose of discussion, the method 1200 will be described from the perspective of the first apparatus 751 in FIG. 7, which may be or may be comprised in a terminal device.

[125] At block 1210, the first apparatus 751 receives, from a source network node
25 for a first apparatus, at least one common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality of candidate target cells in a message without duplicates of information elements (IEs) comprising the at least one common LTM configuration, the first apparatus being configured with a conditional handover and LTM concurrently, and the plurality of candidate target
30 cells being selected by the second apparatus for the conditional handover of the first apparatus.

[126] At block 1220, in accordance with a determination that a target cell is selected

from the plurality of candidate target cells for the conditional handover, the first apparatus 751 applies one of the at least one common LTM configuration related to the target cell.

[127] In some example embodiments, a common LTM configuration of the at least one common LTM configuration is comprised in an IE of a radio resource control (RRC) message. In some example embodiments, the common LTM configuration may be comprised in a single IE of the RRC message.

[128] In some example embodiments, the method 1200 comprises: receiving, from the source network node, a common LTM configuration across the plurality of candidate target cells as a part of a conditional reconfiguration for the terminal device.

[129] In some example embodiments, the common LTM configuration is comprised in a first IE for the conditional reconfiguration in a RRC message, and wherein the RRC message comprises a plurality of IEs for delta RRC reconfigurations corresponding to the plurality of candidate target cells, the first IE and the plurality of IEs being at a same level in an information structure in the RRC message.

[130] In some example embodiments, the method 1200 comprises: receiving, from the source network node, the at least one common LTM configuration across the plurality of candidate target cells and a first indication indicating at least one condition for applying the at least one common LTM configuration, respectively.

[131] In some example embodiments, the first indication indicates at least one condition to be evaluated by the terminal device for the conditional handover.

[132] In some example embodiments, the at least one common LTM configuration is comprised in a first IE and the first indication is comprised in a second IE in a RRC message, the first IE and the second IE being at a same level in an information structure of in the RRC message.

[133] In some example embodiments, the method 1200 comprises: receiving, from the source network node, the at least one common LTM configuration across the plurality of candidate target cells; and receiving, from the source network node, a plurality of delta RRC reconfigurations corresponding to the plurality of candidate target cells, a delta RRC reconfiguration among the plurality of delta RRC reconfigurations comprising a second indication indicating one of the at least one

common LTM configuration.

[134] In some example embodiments, two or more second indications in two or more of the plurality of delta RRC reconfigurations point to a same one of the at least one common LTM configuration.

5 [135] In some example embodiments, the plurality of delta RRC reconfigurations corresponding to the plurality of candidate target cells and the at least one common LTM configuration are comprised in a level of a RRC message, and the at least one common LTM configuration is comprised in another level of the RRC message than the plurality of delta RRC reconfigurations.

10 [136] In some example embodiments, the conditional handover comprises conditional LTM, and/or wherein the first apparatus is or is comprised in a central unit (CU) of a target network node for the terminal device.

[137] In some example embodiments, the conditional handover comprises conditional LTM, and/or wherein the first apparatus is or is comprised in the
15 terminal device.

[138] FIG. 13 shows a flowchart of an example method 1300 implemented at a second device in accordance with some example embodiments of the present disclosure. For the purpose of discussion, the method 1300 will be described from the perspective of the second apparatus 752 in FIG. 7, which may be or may be
20 comprised in a target network node of a target cell.

[139] At block 1310, the second apparatus 752 determines at least one common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality of candidate target cells, the terminal device being configured with a conditional handover and LTM concurrently, and the plurality of candidate target cells being
25 selected by the second apparatus for the conditional handover of the terminal device.

[140] At block 1320, the second apparatus 752 transmits, to a source network node in a source cell of the terminal device, the at least one common LTM configuration in a message without duplicates of information elements (IEs) comprising the at least one common LTM configuration.

30 [141] In some example embodiments, the method 1300 comprises: identifying, from the plurality of candidate target cells for the conditional handover of the terminal

device, two or more candidate target cells sharing an LTM configuration; and determining the common LTM configuration corresponding to the shared LTM configuration of the two or more candidate target cells.

[142] In some example embodiments, a common LTM configuration of the at least one common LTM configuration is comprised in an IE of a radio resource control (RRC) message. In some example embodiments, the common LTM configuration may be comprised in a single IE of the RRC message.

[143] In some example embodiments, the method 1300 comprises: transmitting, to the source network node, a common LTM configuration across the plurality of candidate target cells as a part of a conditional reconfiguration for the terminal device.

[144] In some example embodiments, the common LTM configuration is comprised in a first IE for the conditional reconfiguration in a RRC message, and wherein the RRC message comprises a plurality of IEs for delta RRC reconfigurations corresponding to the plurality of candidate target cells, the first IE and the plurality of IEs being at a same level in an information structure in the RRC message.

[145] In some example embodiments, the method 1300 comprises: transmitting, to the source network node, the at least one common LTM configuration across the plurality of candidate target cells and a first indication indicating at least one condition for applying the at least one common LTM configuration, respectively.

[146] In some example embodiments, the first indication indicates at least one condition to be evaluated by the terminal device for the conditional handover.

[147] In some example embodiments, the at least one common LTM configuration is comprised in a first IE and the first indication is comprised in a second IE in a RRC message, the first IE and the second IE being at a same level in an information structure of in the RRC message.

[148] In some example embodiments, the method 1300 comprises: transmitting, to the source network node, the at least one common LTM configuration across the plurality of candidate target cells; and transmitting, to the source network node, a plurality of delta RRC reconfigurations corresponding to the plurality of candidate target cells, a delta RRC reconfiguration among the plurality of delta RRC reconfigurations comprising a second indication indicating one of the at least one

common LTM configuration.

[149] In some example embodiments, two or more second indications in two or more of the plurality of delta RRC reconfigurations point to a same one of the at least one common LTM configuration.

5 [150] In some example embodiments, the plurality of delta RRC reconfigurations corresponding to the plurality of candidate target cells and the at least one common LTM configuration are comprised in a level of a RRC message, and the at least one common LTM configuration is comprised in another level of the RRC message than the plurality of delta RRC reconfigurations.

10 [151] In some example embodiments, the conditional handover comprises conditional LTM, and/or wherein the second apparatus is or is comprised in a central unit (CU) of a target network node for the terminal device.

[152] FIG. 14 shows a flowchart of an example method 1400 implemented at a third device in accordance with some example embodiments of the present disclosure.

15 For the purpose of discussion, the method 1400 will be described from the perspective of the third apparatus 753 in FIG.7, which may be or may be comprised in a source network node for a source cell of a terminal device.

[153] At block 1410, the third apparatus 753 receives, from a target network node for a terminal device, at least one common layer 1 or layer 2 (L1/L2) triggered
20 mobility (LTM) configuration across a plurality of candidate target cells, the terminal device being configured with a CHO and LTM concurrently, and the plurality of candidate target cells being selected by the second apparatus for the CHO of the terminal device.

[154] At block 1420, the third apparatus 753 transmits the at least one common LTM
25 configuration to the terminal device in a further message without duplicates of IEs comprising the at least one common LTM configuration.

[155] In some example embodiments, a common LTM configuration of the at least one common LTM configuration is comprised in an IE of a radio resource control (RRC) message. In some example embodiments, the common LTM configuration
30 may be comprised in a single IE of the RRC message.

[156] In some example embodiments, the method 1400 comprises: receiving, from

the target network node, the common LTM configuration across the plurality of candidate target cells as a part of a conditional reconfiguration for the terminal device.

[157] In some example embodiments, the method 1400 further comprises:
5 transmitting, to the terminal device, the common LTM configuration in a first IE for the conditional reconfiguration in a RRC message; and transmitting, to the terminal device, a plurality of delta RRC reconfigurations corresponding to the plurality of candidate target cells in a plurality of IEs of the RRC message, the first IE and the plurality of IEs being at a same level in an information structure in the RRC message.

10 [158] In some example embodiments, the method 1400 comprises: receiving, from the target network node, the at least one common LTM configuration across the plurality of candidate target cells and a first indication indicating at least one condition for applying the at least one common LTM configuration, respectively.

[159] In some example embodiments, the first indication indicates at least one
15 condition to be evaluated by the terminal device for the conditional handover.

[160] In some example embodiments, the method 1400 comprises: transmitting, to the terminal device, the at least one common LTM configuration in a first IE and the first indication in a second IE in a RRC message, the first IE and the second IE being at a same level in an information structure of in the RRC message.

20 [161] In some example embodiments, the method 1400 comprises: receiving, from the target network node, the at least one common LTM configuration across the plurality of candidate target cells; and receiving, from the target network node, a plurality of delta RRC reconfigurations corresponding to the plurality of candidate target cells, a delta RRC reconfiguration among the plurality of delta RRC
25 reconfigurations comprising a second indication indicating one of the at least one common LTM configuration.

[162] In some example embodiments, two or more second indications in two or more of the plurality of delta RRC reconfigurations point to a same one of the at least one common LTM configuration.

30 [163] In some example embodiments, the method 1400 comprises: transmitting, to the terminal device, the plurality of delta RRC reconfigurations corresponding to the plurality of candidate target cells in a level of a RRC message; and transmitting, to

the terminal device, the at least one common LTM configuration in another level of the RRC message than the plurality of delta RRC reconfigurations.

[164] In some example embodiments, the conditional handover comprises conditional LTM, and/or wherein the third apparatus is or is comprised in a central unit (CU) of a source network node for the terminal device.

[165] In some example embodiments, a first apparatus capable of performing any of the method 1200 (for example, the first apparatus 751 in FIG. 7) may comprise means for performing the respective operations of the method 1200. The means may be implemented in any suitable form. For example, the means may be implemented in a circuitry or software module. The first apparatus may be implemented as or included in the first apparatus 751 in FIG. 7.

[166] In some example embodiments, the first apparatus comprises means for receiving, from a source network node for a first apparatus, at least one common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality of candidate target cells in a message without duplicates of information elements (IEs) comprising the at least one common LTM configuration, the first apparatus being configured with a conditional handover and LTM concurrently, and the plurality of candidate target cells being selected by the second apparatus for the conditional handover of the first apparatus; and means for in accordance with a determination that a target cell is selected from the plurality of candidate target cells for the conditional handover, applying one of the at least one common LTM configuration related to the target cell.

[167] In some example embodiments, the at least one common LTM configuration is comprised in an IE of a radio resource control (RRC) message.

[168] In some example embodiments, the first apparatus further comprises: means for receiving, from the source network node, the common LTM configuration across the plurality of candidate target cells as a part of a conditional reconfiguration for the terminal device.

[169] In some example embodiments, the common LTM configuration is comprised in a first IE for the conditional reconfiguration in a RRC message, and wherein the RRC message comprises a plurality of IEs for delta RRC reconfigurations corresponding to the plurality of candidate target cells, the first IE and the plurality

of IEs being at a same level in an information structure in the RRC message.

[170] In some example embodiments, the first apparatus further comprises: means for receiving, from the source network node, the at least one common LTM configuration across the plurality of candidate target cells and a first indication
5 indicating at least one condition for applying the at least one common LTM configuration, respectively.

[171] In some example embodiments, the first indication indicates at least one condition to be evaluated by the terminal device for the conditional handover.

[172] In some example embodiments, the at least one common LTM configuration
10 is comprised in a first IE and the first indication is comprised in a second IE in a RRC message, the first IE and the second IE being at a same level in an information structure of in the RRC message.

[173] In some example embodiments, the first apparatus further comprises: means for receiving, from the source network node, the at least one common LTM configuration across the plurality of candidate target cells; and means for receiving,
15 from the source network node, a plurality of delta RRC reconfigurations corresponding to the plurality of candidate target cells, a delta RRC reconfiguration among the plurality of delta RRC reconfigurations comprising a second indication indicating one of the at least one common LTM configuration.

[174] In some example embodiments, two or more second indications in two or more
20 of the plurality of delta RRC reconfigurations point to a same one of the at least one common LTM configuration.

[175] In some example embodiments, the plurality of delta RRC reconfigurations corresponding to the plurality of candidate target cells and the at least one common
25 LTM configuration are comprised in a level of a RRC message, and the at least one common LTM configuration is comprised in another level of the RRC message than the plurality of delta RRC reconfigurations.

[176] In some example embodiments, the conditional handover comprises conditional LTM, and/or wherein the first apparatus is or is comprised in a central
30 unit (CU) of a target network node for the terminal device.

[177] In some example embodiments, the conditional handover comprises

conditional LTM, and/or wherein the first apparatus is or is comprised in the terminal device.

[178] In some example embodiments, the first apparatus further comprises means for performing other operations in some example embodiments of the method 1200
5 or the first apparatus 751. In some example embodiments, the means comprises at least one processor; and at least one memory storing instructions that, when executed by the at least one processor, cause the performance of the first apparatus.

[179] In some example embodiments, a second apparatus capable of performing any of the method 1300 (for example, the second apparatus 752 in FIG. 7) may comprise
10 means for performing the respective operations of the method 1300. The means may be implemented in any suitable form. For example, the means may be implemented in a circuitry or software module. The second apparatus may be implemented as or included in the second apparatus 752 in FIG. 7.

[180] In some example embodiments, the second apparatus comprises means for
15 determining at least one common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality of candidate target cells, the terminal device being configured with a conditional handover and LTM concurrently, and the plurality of candidate target cells being selected by the second apparatus for the conditional handover of the terminal device; and means for transmitting, to a source network
20 node in a source cell of the terminal device, the at least one common LTM configuration in a message without duplicates of information elements (IEs) comprising the at least one common LTM configuration.

[181] In some example embodiments, the second apparatus further comprises: means for identifying, from the plurality of candidate target cells for the conditional
25 handover of the terminal device, two or more candidate target cells sharing an LTM configuration; and means for determining the common LTM configuration corresponding to the shared LTM configuration of the two or more candidate target cells.

[182] In some example embodiments, the at least one common LTM configuration
30 is comprised in an IE of a radio resource control (RRC) message.

[183] In some example embodiments, the second apparatus further comprises: means for transmitting, to the source network node, the common LTM configuration across

the plurality of candidate target cells as a part of a conditional reconfiguration for the terminal device.

[184] In some example embodiments, the common LTM configuration is comprised in a first IE for the conditional reconfiguration in a RRC message, and wherein the
5 RRC message comprises a plurality of IEs for delta RRC reconfigurations corresponding to the plurality of candidate target cells, the first IE and the plurality of IEs being at a same level in an information structure in the RRC message.

[185] In some example embodiments, the second apparatus further comprises: means for transmitting, to the source network node, the at least one common LTM
10 configuration across the plurality of candidate target cells and a first indication indicating at least one condition for applying the at least one common LTM configuration, respectively.

[186] In some example embodiments, the first indication indicates at least one condition to be evaluated by the terminal device for the conditional handover.

15 [187] In some example embodiments, the at least one common LTM configuration is comprised in a first IE and the first indication is comprised in a second IE in a RRC message, the first IE and the second IE being at a same level in an information structure of in the RRC message.

[188] In some example embodiments, the second apparatus further comprises: means
20 for transmitting, to the source network node, the at least one common LTM configuration across the plurality of candidate target cells; and means for transmitting, to the source network node, a plurality of delta RRC reconfigurations corresponding to the plurality of candidate target cells, a delta RRC reconfiguration among the plurality of delta RRC reconfigurations comprising a second indication
25 indicating one of the at least one common LTM configuration.

[189] In some example embodiments, two or more second indications in two or more of the plurality of delta RRC reconfigurations point to a same one of the at least one common LTM configuration.

[190] In some example embodiments, the plurality of delta RRC reconfigurations
30 corresponding to the plurality of candidate target cells and the at least one common LTM configuration are comprised in a level of a RRC message, and the at least one common LTM configuration is comprised in another level of the RRC message than

the plurality of delta RRC reconfigurations.

[191] In some example embodiments, the conditional handover comprises conditional LTM, and/or wherein the second apparatus is or is comprised in a central unit (CU) of a target network node for the terminal device.

5 [192] In some example embodiments, the second apparatus further comprises means for performing other operations in some example embodiments of the method 1300 or the second apparatus 752. In some example embodiments, the means comprises at least one processor; and at least one memory storing instructions that, when executed by the at least one processor, cause the performance of the second
10 apparatus.

[193] In some example embodiments, a third apparatus capable of performing any of the method 1400 (for example, the third apparatus 753 in FIG. 7) may comprise means for performing the respective operations of the method 1400. The means may be implemented in any suitable form. For example, the means may be implemented
15 in a circuitry or software module. The third apparatus may be implemented as or included in the third apparatus 753 in FIG. 7.

[194] In some example embodiments, the third apparatus comprises means for receiving, from a target network node for a terminal device, at least one common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality
20 of candidate target cells, the terminal device being configured with a CHO and LTM concurrently, and the plurality of candidate target cells being selected by the second apparatus for the CHO of the terminal device; and means for transmitting the at least one common LTM configuration to the terminal device in a further message without duplicates of IEs comprising the at least one common LTM configuration.

25 [195] In some example embodiments, the at least one common LTM configuration is comprised in an IE of a radio resource control (RRC) message.

[196] In some example embodiments, the third apparatus further comprises: means for receiving, from the target network node, the common LTM configuration across the plurality of candidate target cells as a part of a conditional reconfiguration for
30 the terminal device.

[197] In some example embodiments, the third apparatus further comprises: means for transmitting, to the terminal device, the common LTM configuration in a first IE

for the conditional reconfiguration in a RRC message; and means for transmitting, to the terminal device, a plurality of delta RRC reconfigurations corresponding to the plurality of candidate target cells in a plurality of IEs of the RRC message, the first IE and the plurality of IEs being at a same level in an information structure in
5 the RRC message.

[198] In some example embodiments, the third apparatus further comprises: means for receiving, from the target network node, the at least one common LTM configuration across the plurality of candidate target cells and a first indication indicating at least one condition for applying the at least one common LTM
10 configuration, respectively.

[199] In some example embodiments, the first indication indicates at least one condition to be evaluated by the terminal device for the conditional handover.

[200] In some example embodiments, the third apparatus further comprises: means for transmitting, to the terminal device, the at least one common LTM configuration
15 in a first IE and the first indication in a second IE in a RRC message, the first IE and the second IE being at a same level in an information structure of in the RRC message.

[201] In some example embodiments, the third apparatus further comprises: means for receiving, from the target network node, the at least one common LTM
20 configuration across the plurality of candidate target cells; and means for receiving, from the target network node, a plurality of delta RRC reconfigurations corresponding to the plurality of candidate target cells, a delta RRC reconfiguration among the plurality of delta RRC reconfigurations comprising a second indication indicating one of the at least one common LTM configuration.

25 [202] In some example embodiments, two or more second indications in two or more of the plurality of delta RRC reconfigurations point to a same one of the at least one common LTM configuration.

[203] In some example embodiments, the third apparatus further comprises: means for transmitting, to the terminal device, the plurality of delta RRC reconfigurations
30 corresponding to the plurality of candidate target cells in a level of a RRC message; and means for transmitting, to the terminal device, the at least one common LTM configuration in another level of the RRC message than the plurality of delta RRC

reconfigurations.

[204] In some example embodiments, the conditional handover comprises conditional LTM, and/or wherein the third apparatus is or is comprised in a central unit (CU) of a source network node for the terminal device.

5 [205] In some example embodiments, the third apparatus further comprises means for performing other operations in some example embodiments of the method 1400 or the third apparatus 753. In some example embodiments, the means comprises at least one processor; and at least one memory storing instructions that, when executed by the at least one processor, cause the performance of the third apparatus.

10 [206] FIG. 15 is a simplified block diagram of a device 1500 that is suitable for implementing example embodiments of the present disclosure. The device 1500 may be provided to implement a communication device, for example, the first apparatus 751 or the second apparatus 752 as shown in FIG. 7. As shown, the device 1500 includes one or more processors 1510, one or more memories 1520 coupled to the
15 processor 1510, and one or more communication modules 1540 coupled to the processor 1510.

[207] The communication module 1540 is for bidirectional communications. The communication module 1540 has one or more communication interfaces to facilitate communication with one or more other modules or devices. The communication
20 interfaces may represent any interface that is necessary for communication with other network elements. In some example embodiments, the communication module 1540 may include at least one antenna.

[208] The processor 1510 may be of any type suitable to the local technical network and may include one or more of the following: general purpose computers, special
25 purpose computers, microprocessors, digital signal processors (DSPs) and processors based on multicore processor architecture, as non-limiting examples. The device 1500 may have multiple processors, such as an application specific integrated circuit chip that is slaved in time to a clock which synchronizes the main processor.

[209] The memory 1520 may include one or more non-volatile memories and one or
30 more volatile memories. Examples of the non-volatile memories include, but are not limited to, a Read Only Memory (ROM) 1524, an electrically programmable read only memory (EPROM), a flash memory, a hard disk, a compact disc (CD), a digital

video disk (DVD), an optical disk, a laser disk, and other magnetic storage and/or optical storage. Examples of the volatile memories include, but are not limited to, a random access memory (RAM) 1522 and other volatile memories that will not last in the power-down duration.

5 [210] A computer program 1530 includes computer executable instructions that are executed by the associated processor 1510. The instructions of the program 1530 may include instructions for performing operations/acts of some example embodiments of the present disclosure. The program 1530 may be stored in the memory, e.g., the ROM 1524. The processor 1510 may perform any suitable actions
10 and processing by loading the program 1530 into the RAM 1522.

[211] The example embodiments of the present disclosure may be implemented by means of the program 1530 so that the device 1500 may perform any process of the disclosure as discussed with reference to FIG. 7 to FIG. 14. The example embodiments of the present disclosure may also be implemented by hardware or by
15 a combination of software and hardware.

[212] In some example embodiments, the program 1530 may be tangibly contained in a computer readable medium which may be included in the device 1500 (such as in the memory 1520) or other storage devices that are accessible by the device 1500. The device 1500 may load the program 1530 from the computer readable medium to
20 the RAM 1522 for execution. In some example embodiments, the computer readable medium may include any types of non-transitory storage medium, such as ROM, EPROM, a flash memory, a hard disk, CD, DVD, and the like. The term “non-transitory,” as used herein, is a limitation of the medium itself (i.e., tangible, not a signal) as opposed to a limitation on data storage persistency (e.g., RAM vs. ROM).

25 [213] FIG. 16 shows an example of the computer readable medium 1600 which may be in form of CD, DVD or other optical storage disk. The computer readable medium 1600 has the program 1530 stored thereon.

[214] Generally, various embodiments of the present disclosure may be implemented in hardware or special purpose circuits, software, logic or any combination thereof.
30 Some aspects may be implemented in hardware, and other aspects may be implemented in firmware or software which may be executed by a controller, microprocessor or other computing device. Although various aspects of

embodiments of the present disclosure are illustrated and described as block diagrams, flowcharts, or using some other pictorial representations, it is to be understood that the block, apparatus, system, technique or method described herein may be implemented in, as non-limiting examples, hardware, software, firmware, 5 special purpose circuits or logic, general purpose hardware or controller or other computing devices, or some combination thereof.

[215] Some example embodiments of the present disclosure also provide at least one computer program product tangibly stored on a computer readable medium, such as a non-transitory computer readable medium. The computer program product 10 includes computer-executable instructions, such as those included in program modules, being executed in a device on a target physical or virtual processor, to carry out any of the methods as described above. Generally, program modules include routines, programs, libraries, objects, classes, components, data structures, or the like that perform particular tasks or implement particular abstract data types. 15 The functionality of the program modules may be combined or split between program modules as desired in various embodiments. Machine-executable instructions for program modules may be executed within a local or distributed device. In a distributed device, program modules may be located in both local and remote storage media.

20 [216] Program code for carrying out methods of the present disclosure may be written in any combination of one or more programming languages. The program code may be provided to a processor or controller of a general purpose computer, special purpose computer, or other programmable data processing apparatus, such that the program code, when executed by the processor or controller, cause the 25 functions/operations specified in the flowcharts and/or block diagrams to be implemented. The program code may execute entirely on a machine, partly on the machine, as a stand-alone software package, partly on the machine and partly on a remote machine or entirely on the remote machine or server.

[217] In the context of the present disclosure, the computer program code or related 30 data may be carried by any suitable carrier to enable the device, apparatus or processor to perform various processes and operations as described above. Examples of the carrier include a signal, computer readable medium, and the like.

[218] The computer readable medium may be a computer readable signal medium or

- a computer readable storage medium. A computer readable medium may include but not limited to an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, or device, or any suitable combination of the foregoing. More specific examples of the computer readable storage medium would
- 5 include an electrical connection having one or more wires, a portable computer diskette, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or Flash memory), an optical fiber, a portable compact disc read-only memory (CD-ROM), an optical storage device, a magnetic storage device, or any suitable combination of the foregoing.
- 10 **[219]** Further, although operations are depicted in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results. In certain circumstances, multitasking and parallel processing may be advantageous. Likewise, although several specific
- 15 implementation details are contained in the above discussions, these should not be construed as limitations on the scope of the present disclosure, but rather as descriptions of features that may be specific to particular embodiments. Unless explicitly stated, certain features that are described in the context of separate embodiments may also be implemented in combination in a single embodiment.
- 20 Conversely, unless explicitly stated, various features that are described in the context of a single embodiment may also be implemented in a plurality of embodiments separately or in any suitable sub-combination.
- [220]** Although the present disclosure has been described in languages specific to structural features and/or methodological acts, it is to be understood that the present
- 25 disclosure defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims.
- [221]** Some abbreviations used in the present disclosure are provided below with their representation in unshortened form. It is noted that widely established and
- 30 unique abbreviations can be assumed as known.

List of abbreviations

CHO – Conditional Handover

CU-CP – Central Unit Control Plane

CU-UP – Central Unit User Plane

5 DC – Dual Connectivity

DRB – Data Radio Bearer

HO – Handover

MN – Master Node

NR – New Radio

10 PCell – Primary Cell

PSCell – Primary Secondary Cell

SCG – Secondary Cell Group

SN – Secondary Node

LTM – L1/L2 Triggered Mobility

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WHAT IS CLAIMED IS:

1. A first apparatus comprising:
at least one processor; and
at least one memory storing instructions that, when executed by the at least one
5 processor, cause the first apparatus at least to perform:
receiving, from a source network node for a first apparatus, at least one
common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across
a plurality of candidate target cells in a message without duplicates of information
elements (IEs) comprising the at least one common LTM configuration, the first
10 apparatus being configured with a conditional handover and LTM concurrently,
and the plurality of candidate target cells being selected by the second apparatus
for the conditional handover of the first apparatus; and
in accordance with a determination that a target cell is selected from the
plurality of candidate target cells for the conditional handover, applying one of
15 the at least one common LTM configuration related to the target cell.
2. The apparatus of claim 1, wherein a common LTM configuration of the at least
one common LTM configuration is comprised in an information element (IE) of a radio
resource control (RRC) message.
20
3. The apparatus of any of claims 1 to 2, wherein the first apparatus is caused to
perform:
receiving, from the source network node, a common LTM configuration across
the plurality of candidate target cells as a part of a conditional reconfiguration for the
25 terminal device.
4. The apparatus of claim 3, wherein the common LTM configuration is comprised
in a first IE for the conditional reconfiguration in a RRC message, and
wherein the RRC message comprises a plurality of IEs for delta RRC
30 reconfigurations corresponding to the plurality of candidate target cells, the first IE and
the plurality of IEs being at a same level in an information structure in the RRC message.
5. The apparatus of any of claims 1 to 2, wherein the first apparatus is caused to
perform:

receiving, from the source network node, the at least one common LTM configuration across the plurality of candidate target cells and a first indication indicating at least one condition for applying the at least one common LTM configuration, respectively.

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6. The apparatus of claim 5, wherein the first indication indicates at least one condition to be evaluated by the terminal device for the conditional handover.

7. The apparatus of claim 5 or 6, wherein the at least one common LTM configuration is comprised in a first IE and the first indication is comprised in a second IE in a RRC message, the first IE and the second IE being at a same level in an information structure of in the RRC message.

8. The apparatus of any of claims 1 to 2, wherein the first apparatus is caused to perform:

receiving, from the source network node, the at least one common LTM configuration across the plurality of candidate target cells; and

receiving, from the source network node, a plurality of delta RRC reconfigurations corresponding to the plurality of candidate target cells, a delta RRC reconfiguration among the plurality of delta RRC reconfigurations comprising a second indication indicating one of the at least one common LTM configuration.

9. The apparatus of claim 8, wherein two or more second indications in two or more of the plurality of delta RRC reconfigurations point to a same one of the at least one common LTM configuration.

10. The apparatus of claim 8 or 9, wherein the plurality of delta RRC reconfigurations corresponding to the plurality of candidate target cells and the at least one common LTM configuration are comprised in a level of a RRC message, and the at least one common LTM configuration is comprised in another level of the RRC message than the plurality of delta RRC reconfigurations.

11. The apparatus of any of claims 1 to 10, wherein the conditional handover comprises conditional LTM, and/or

wherein the first apparatus is or is comprised in a central unit (CU) of a target network node for the terminal device.

12. The apparatus of any of claims 1 to 11, wherein the conditional handover
5 comprises conditional LTM, and/or
wherein the first apparatus is or is comprised in the terminal device.

13. A second apparatus comprising:
at least one processor; and
10 at least one memory storing instructions that, when executed by the at least one
processor, cause the second apparatus at least to perform:
determining at least one common layer 1 or layer 2 (L1/L2) triggered
mobility (LTM) configuration across a plurality of candidate target cells, the
terminal device being configured with a conditional handover and LTM
15 concurrently, and the plurality of candidate target cells being selected by the
second apparatus for the conditional handover of the terminal device; and
transmitting, to a source network node in a source cell of the terminal
device, the at least one common LTM configuration in a message without
duplicates of information elements (IEs) comprising the at least one common
20 LTM configuration.

14. The apparatus of claim 13, wherein the second apparatus is caused to perform:
identifying, from the plurality of candidate target cells for the conditional
handover of the terminal device, two or more candidate target cells sharing an LTM
25 configuration; and
determining the common LTM configuration corresponding to the shared LTM
configuration of the two or more candidate target cells.

15. The apparatus of claim 13, wherein a common LTM configuration of the at
30 least one common LTM configuration is comprised in an information element (IE) of a
radio resource control (RRC) message.

16. The apparatus of any of claims 13 to 15, wherein the second apparatus is
caused to perform:

transmitting, to the source network node, a common LTM configuration across the plurality of candidate target cells as a part of a conditional reconfiguration for the terminal device.

5 17. The apparatus of claim 16, wherein the common LTM configuration is comprised in a first IE for the conditional reconfiguration in a RRC message, and

 wherein the RRC message comprises a plurality of IEs for delta RRC reconfigurations corresponding to the plurality of candidate target cells, the first IE and the plurality of IEs being at a same level in an information structure in the RRC message.

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 18. The apparatus of any of claims 13 to 15, wherein the second apparatus is caused to perform:

 transmitting, to the source network node, the at least one common LTM configuration across the plurality of candidate target cells and a first indication indicating
15 at least one condition for applying the at least one common LTM configuration, respectively.

 19. The apparatus of claim 18, wherein the first indication indicates at least one condition to be evaluated by the terminal device for the conditional handover.

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 20. The apparatus of claim 18 or 19, wherein the at least one common LTM configuration is comprised in a first IE and the first indication is comprised in a second IE in a RRC message, the first IE and the second IE being at a same level in an information structure of in the RRC message.

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 21. The apparatus of any of claims 13 to 15, wherein the second apparatus is caused to perform:

 transmitting, to the source network node, the at least one common LTM configuration across the plurality of candidate target cells; and

30 transmitting, to the source network node, a plurality of delta RRC reconfigurations corresponding to the plurality of candidate target cells, a delta RRC reconfiguration among the plurality of delta RRC reconfigurations comprising a second indication indicating one of the at least one common LTM configuration.

22. The apparatus of claim 21, wherein two or more second indications in two or more of the plurality of delta RRC reconfigurations point to a same one of the at least one common LTM configuration.

5 23. The apparatus of claim 21 or 22, wherein the plurality of delta RRC reconfigurations corresponding to the plurality of candidate target cells and the at least one common LTM configuration are comprised in a level of a RRC message, and the at least one common LTM configuration is comprised in another level of the RRC message than the plurality of delta RRC reconfigurations.

10

24. The apparatus of any of claims 13 to 23, wherein the conditional handover comprises conditional LTM, and/or

 wherein the second apparatus is or is comprised in a central unit (CU) of a target network node for the terminal device.

15

25. A third apparatus comprising:
at least one processor; and
at least one memory storing instructions that, when executed by the at least one processor, cause the third apparatus at least to perform:

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 receiving, from a target network node for a terminal device, at least one common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality of candidate target cells, the terminal device being configured with a CHO and LTM concurrently, and the plurality of candidate target cells being selected by the second apparatus for the CHO of the terminal device; and

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 transmitting the at least one common LTM configuration to the terminal device in a further message without duplicates of IEs comprising the at least one common LTM configuration.

26. The apparatus of claim 25, wherein a common LTM configuration of the at least one common LTM configuration is comprised in an information element (IE) of a radio resource control (RRC) message.

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27. The apparatus of claim 25 or 26, wherein the third apparatus is caused to perform:

receiving, from the target network node, a common LTM configuration across the plurality of candidate target cells as a part of a conditional reconfiguration for the terminal device.

- 5 28. The apparatus of claim 27, wherein the third apparatus is caused to perform:
transmitting, to the terminal device, the common LTM configuration in a first IE
for the conditional reconfiguration in a RRC message; and
transmitting, to the terminal device, a plurality of delta RRC reconfigurations
corresponding to the plurality of candidate target cells in a plurality of IEs of the RRC
10 message, the first IE and the plurality of IEs being at a same level in an information
structure in the RRC message.

29. The apparatus of claim 25 or 26, wherein the third apparatus is caused to
perform:
15 receiving, from the target network node, the at least one common LTM
configuration across the plurality of candidate target cells and a first indication indicating
at least one condition for applying the at least one common LTM configuration,
respectively.

- 20 30. The apparatus of claim 29, wherein the first indication indicates at least one
condition to be evaluated by the terminal device for the conditional handover.

31. The apparatus of claim 29 or 30, wherein the third apparatus is caused to
perform:
25 transmitting, to the terminal device, the at least one common LTM configuration
in a first IE and the first indication in a second IE in a RRC message, the first IE and the
second IE being at a same level in an information structure of in the RRC message.

32. The apparatus of claim 25 or 26, wherein the third apparatus is caused to
30 perform:
receiving, from the target network node, the at least one common LTM
configuration across the plurality of candidate target cells; and
receiving, from the target network node, a plurality of delta RRC reconfigurations
corresponding to the plurality of candidate target cells, a delta RRC reconfiguration

among the plurality of delta RRC reconfigurations comprising a second indication indicating one of the at least one common LTM configuration.

33. The apparatus of claim 32, wherein two or more second indications in two or
5 more of the plurality of delta RRC reconfigurations point to a same one of the at least one common LTM configuration.

34. The apparatus of claim 32 or 33, wherein the third apparatus is caused to
perform:
10 transmitting, to the terminal device, the plurality of delta RRC reconfigurations corresponding to the plurality of candidate target cells in a level of a RRC message; and
transmitting, to the terminal device, the at least one common LTM configuration in another level of the RRC message than the plurality of delta RRC reconfigurations.

15 35. The apparatus of any of claims 25 to 34, wherein the conditional handover comprises conditional LTM, and/or

wherein the third apparatus is or is comprised in a central unit (CU) of a source network node for the terminal device.

20 36. A method comprising:
receiving, at a first apparatus and from a source network node for a first apparatus, at least one common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality of candidate target cells in a message without duplicates of information elements (IEs) comprising the at least one common LTM configuration, the first
25 apparatus being configured with a conditional handover and LTM concurrently, and the plurality of candidate target cells being selected by the second apparatus for the conditional handover of the first apparatus; and

in accordance with a determination that a target cell is selected from the plurality of candidate target cells for the conditional handover, applying one of the at least one
30 common LTM configuration related to the target cell.

37. A method comprising:
determining, at a second apparatus, at least one common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality of candidate target cells, the

terminal device being configured with a conditional handover and LTM concurrently, and the plurality of candidate target cells being selected by the second apparatus for the conditional handover of the terminal device; and

transmitting, to a source network node in a source cell of the terminal device, the
5 at least one common LTM configuration in a message without duplicates of information elements (IEs) comprising the at least one common LTM configuration.

38. A method comprising:

receiving, at a third apparatus and from a target network node for a terminal device,
10 at least one common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality of candidate target cells, , the terminal device being configured with a CHO and LTM concurrently, and the plurality of candidate target cells being selected by the second apparatus for the CHO of the terminal device; and

transmitting the at least one common LTM configuration to the terminal device in
15 a further message without duplicates of IEs comprising the at least one common LTM configuration.

39. A first apparatus comprising:

means for receiving, from a source network node for a first apparatus, at least one
20 common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality of candidate target cells in a message without duplicates of information elements (IEs) comprising the at least one common LTM configuration, , the first apparatus being configured with a conditional handover and LTM concurrently, and the plurality of candidate target cells being selected by the second apparatus for the conditional handover
25 of the first apparatus; and

means for in accordance with a determination that a target cell is selected from the plurality of candidate target cells for the conditional handover, applying one of the at least one common LTM configuration related to the target cell.

30 40. A second apparatus comprising:

means for determining at least one common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality of candidate target cells, the terminal device being configured with a conditional handover and LTM concurrently, and the plurality of candidate target cells being selected by the second apparatus for the

conditional handover of the terminal device; and

means for transmitting, to a source network node in a source cell of the terminal device, the at least one common LTM configuration in a message without duplicates of information elements (IEs) comprising the at least one common LTM configuration.

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41. A third apparatus comprising:

means for receiving, from a target network node for a terminal device, at least one common layer 1 or layer 2 (L1/L2) triggered mobility (LTM) configuration across a plurality of candidate target cells, , the terminal device being configured with a CHO and

10 LTM concurrently, and the plurality of candidate target cells being selected by the second apparatus for the CHO of the terminal device; and

means for transmitting the at least one common LTM configuration to the terminal device in a further message without duplicates of IEs comprising the at least one common LTM configuration.

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42. A computer readable medium comprising instructions stored thereon for causing an apparatus at least to perform the method of claim 36, the method of claim 37, or the method of claim 38.